Chapter 1

LHB Design Coach

INTRODUCTION

Linke Hofmann Busch (LHB) coaches are the passenger coaches of Indian Railways that have been developed by Linke-Hofmann-Busch of Germany (renamed Alstom LHB GmbH in 1998 after the takeover by Alstom) and produced initially by Rail Coach Factory, Kapurthala, India. Now LHB coaches are also manufactured at Integral Coach Factory, Chennai and Modern Coach Factory, Raibareli.

To bring a quantum jump in passenger coach technology and bring it to the contemporary world standards under Transfer of Technology Contract with M/s Alstom-LHB, Germany, RCF has successfully rolled out Alstom-LHB design stainless steel coaches for Rajdhani & Shatabadi Express trains initially and now all type of classes are being manufactured in a big scale. The bogies for these coaches are of FIAT design providing faster, comfortable and safe travel.

Operational & Maintenance Superiority

- **Stainless steel shell** to eliminate corrosion.
- **Extra passenger carrying capacity**.
- **Lower coach weight** leading to lower **hauling cost**.
- Maximum operating **speed of 160 kmph** and tested upto 180 kmph. (Upgradable to 200 kmph)
- **Disc brakes** for efficient braking and **lesser maintenance**.
- **Wheel slide protection** prevents wheel flats.
- Maintenance free**Cartridge Taper Roller Bearings**.
- **Better curve negotiation** due to articulated control arm fitted with resilient bush.
- Lesser maintenance leading to **improved availability**.

Improved Passenger Interface

- FIAT bogie which is an adoption of **Eurofima design** provides improved **ride index of 2.5** at 160 kmph.
- Plush interiors.
- Improved **panoramic view** through bigger windows.
- Modular toilets initially with controlled discharge system to avoid soiling of station premises. CDTS toilets are now being replaced with **Bio Toilets**.
- **Wider vestibules** for easier inter-coach movement.

Improved Safety

- **Centre Buffer Coupler** with **anti-climbing features**.
- 4 emergency exit windows for **faster passenger evacuation**.
- **Fire retardant furnishing**.

SHELL

The LHB Coach is of integral light weight construction, consisting of separate assembly group of underframe, sidewalls, roof and end walls. The individual assemblies are joined to each other by welding. Three types of steel are used for manufacture of body shell.

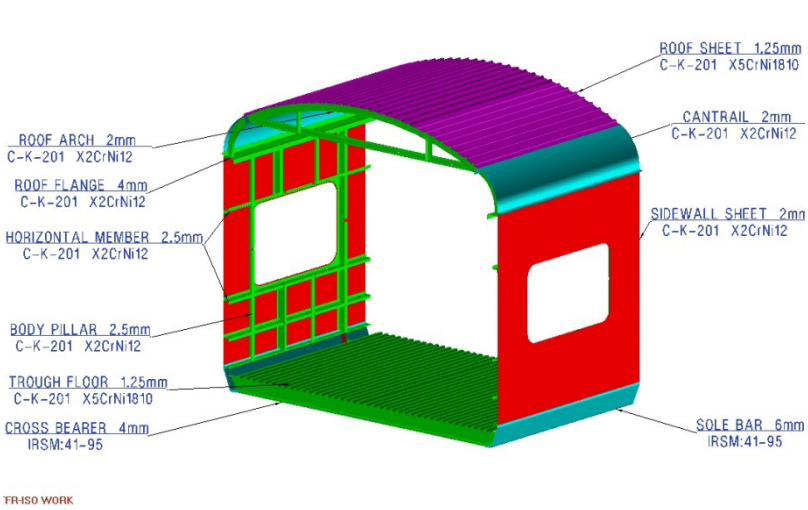
Shell Assemblies	Steels used and their %agecompositions	UTS N/mm2	Yield Stress N/mm2
Side wall, End wall and Roof structure	X2Crni12 Ferritic steel (SS 409M) (C</= .03%, Cr 10.5-12.5%, Si 1%, Mn0.5-1.5%	450-600	320
Roof sheet and Trough floor	X2CrNi1810 Austenitic steel (SS 304) (C </=0.07%, Cr 17-19%, Si 1% max , Mn2.0% max)	550-750	235
Under frame	IRS M-41 / Corten Steel (C 0.01% max, Cr 0.35 -0.6%, Ni 0.2 -0.47% Cu 0.3 - 0.6% Si 0.28 -0 .72%, Mn0.25 to 0.45%)	440-480	320

Important body shell features that make LHB Coach Shell superior to ICF coach:

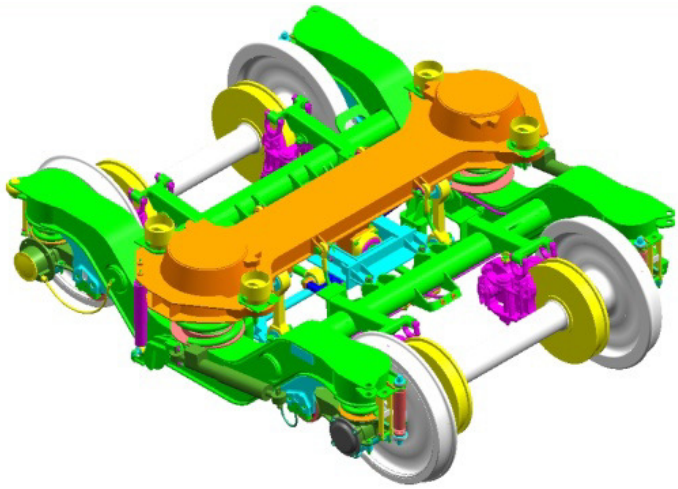
1. **Heat and Sound Insulation**
   - Heat insulation of the floor side of the side wall lower area and end wall is done with **Resonaflex insulation mat**.
   - Use of **Resonaflex and BaryskinV60-B paint** in the shell, etc. Results in superior noise and thermal insulation.
   - The noise level inside the coach is limited to **60 dB**.
   - **PU paint** on full coach shell interior provide anti drumming sound insulation.
2. **YAW Damper**
   Yaw dampers are provided which connects the bogie frame and underframe of the coach, which controls the Yaw movement of the coach and adds to better riding quality.
3. **Floor**
   Floor is provided with Stainless steel trough over which, rubber “De-coupling” and Makore sandwich (cork) floor board. This insulates heat & sound and damps vibrations.

Flooring boards resting on Rubber De- Coupling elements

Flooring boards – Cork Sandwiched between COMPREG to absorb noise



FIAT BOGIE



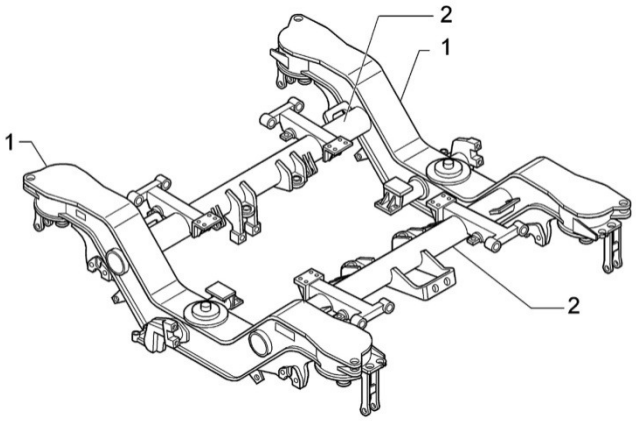
The FIAT bogies have no metal wearing parts. For improved ride quality, nine dampers have been provided in each bogie. FIAT bogie Rubber suspension components and cartridge tapered roller bearings have also been used.

Salient Features of FIAT Bogie

- FIAT bogie is built with "Y DIP FRAME" which facilitates to lower the Centre of Gravity.
- Its shorter wheel base enables for a better curve negotiation.
- Cartridge Tapered Roller Bearing has an advantage of better life cycle against axle loads.
- Anti-Roll Bar is provided in FIAT bogie to control Role frequency and displacement.
- FIAT Bogie is provided with disc brake system which enables shorter emergency stopping distance.
- Lateral and longitudinal bump stop controls the coach movement with respect to bogie.

Vital Components of FIAT Bogie

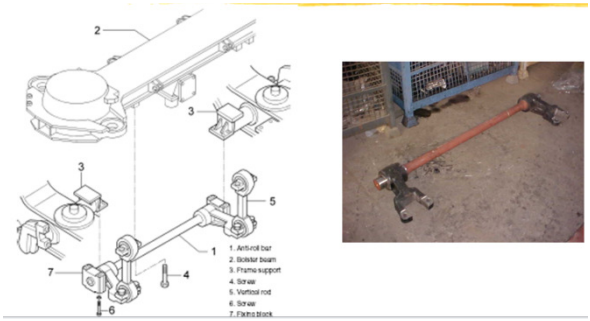
i. Y Dip Frame



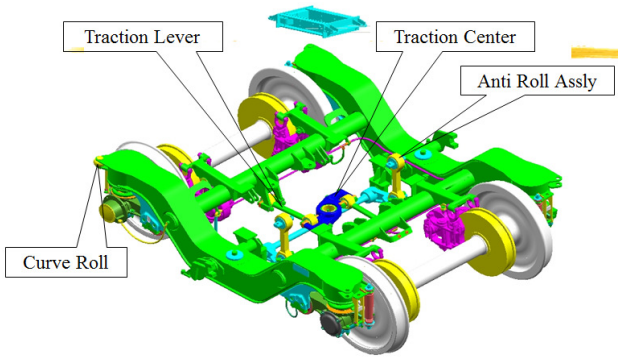
The frame is made up of two longitudinal components (1) connected by two cross-beams (2) which also support the brake units. The various supports which connect the different bogie components are welded to the frame. The bogie frame rests on the primary suspension spring units and supports the vehicle body by means of a bolster beam. The bolster beam is connected to the bogie frame by the secondary suspension.

ii. Anti-Roll bar

It is a torsion bar with two forks between bogie frame & bolster connected by Roll links. Anti-Roll bar Resists the Rolling motion of Coach.

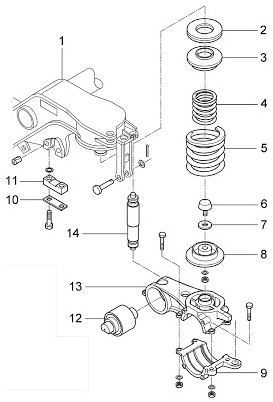


iii. Traction Centre



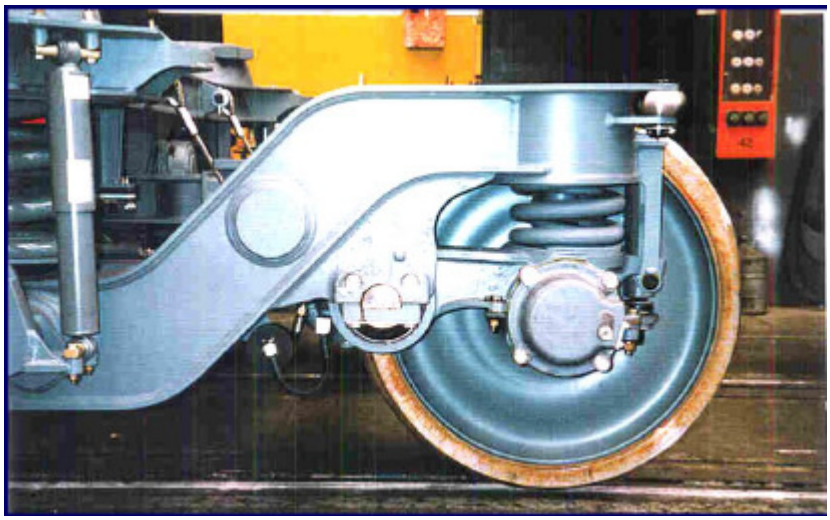
Traction Centre transmits tractive forces and braking forces between the body and the bogie. It is provided with two Traction Levers which connect beam of bogie and the traction centre.

iv. Control Arm



1. Bogie Frame
2. Rubber disc
3. Cantering disc
4. Internal Spring
5. External Spring
6. Bump Stop
7. Shim
8. Cantering Disc
9. **Control Arm lower part**
10. Plate
11. Block
12. Rubber joint
13. **Control Arm Upper part**
14. Damper

Control arm (13) is a part of primary suspension, fitted with twin-layer elastic joints (12), connecting the axle bearing to the bogie frame and transmitting, not stiffly, lateral, longitudinal and part of the vertical forces.



Articulated Control Arm system transmits the tractive and braking forces between the bogie assembly and the wheel/axle assembly.

- Controlled guidance of Axle with respect to Bogie
- Controlled energy transfer
- Lateral flexibility- Reduce root wear
- Transmit traction & braking forces between Axle and Bogie

Control Arm is a critical part FIAT bogie and needs to be maintained with great care.

As per RDSO instructions vide **RDSO Letter No. SV.FIAT dated 03.04.2018**, the following maintenance practices to be followed in workshops during Shop Schedules:

i. The fasteners used in control arm shall be of **property class 10.9**
ii. **Self-locking washers** are to be provided. Plain washers should not be used.

iii. The **fasteners shall be tightened to a torque of 170N-m** with a calibrated torque wrench. After tightening a paint mark to be made for visual indication in case of loosening of the bolt. The paint mark should be examined in every schedule.

iv. The **orientation and grouping of inner and outer primary springs** should be ensured per RDSO maintenance instructions ***CMI no. RDSO/2017/CG/CMI-01*** issued in January 2017.

v. All the **dampers of the bogies should be tested** during Shop Schedule and defective dampers should not be allowed in service.

i. Remove signs of corrosion/wear

ii. Renew corrosion protection: **Application of "Blasol–135" solution at Bearing mating surface**

iii. **Examine the rubber joint for cracks/damage and ageing**. Replace, if necessary.

S.No.	Parameter	limit	Action
1	Control arm bore(X) mm	X > 230.5	Reject
		230.312 > X > 230.5	Re-machine*
		X < 230.312	Reuse

v. Secondary Suspension

The secondary suspension enables lateral and vertical displacements and bogie rotation with respect to body when running through curves. It is implemented by two spring packs which sustain the bolster beam over the bogie frame.

Each spring pack is made up by an internal and an external spring mounted and positioned through the centering discs.

An Anti-roll bar, fitted on the bogie frame, realizes a constant, reduced inclination coefficient during running.

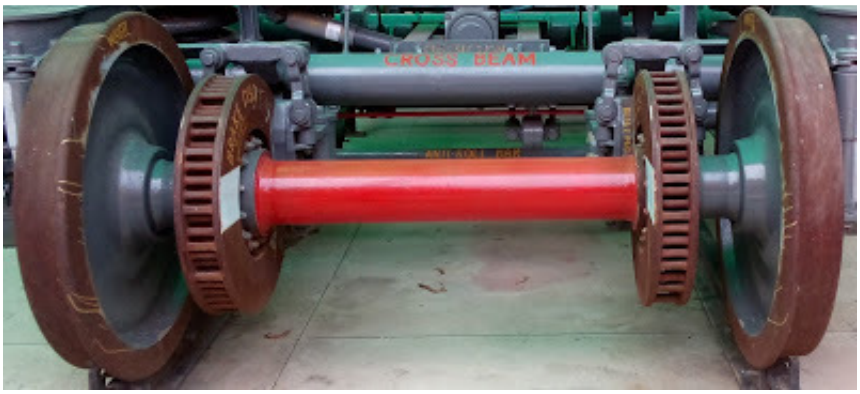
The bogie frame is linked to the bolster beam through two vertical dampers, a lateral damper, four safety cables and the traction rods.

Air spring (Pneumatic suspension) in secondary suspension stage.

Air suspension is a suspension where properties of air are used for cushioning effect (springiness). Enclosed pressurised air in a pre-defined chamber called air spring, made up of rubber bellow & emergency rubber spring, provides various suspension characteristics including damping.

vi. Wheel &Axle Assembly

Wheel & axle assembly consists of axle mounted with two disc brakes and is fitted with cartridge roller bearing. A phonic wheel arrangement is made at one end of axle to enable the speed sensor to send the speed signals to microprocessor. An earthing device is also provided for each bogie.



Chapter 2

Comparison of LHB and ICF Coaches

Features of LHB Air brake system:

Axle mounted Disc braking system provided in LHB coaches for effective braking there by reducing emergency braking distance.

- A Brake Panel with an Aluminium Slab manifold accommodates the Critical Valves of the brake system. This provision protects the Valves from the vulnerability of impact damages from ballast / flying debris during train operations, eliminate substantial piping work and facilitate maintenance by unit replacement. It also contains test points for checking the pressures of BP, AR, DV, BC and CR outputs at one location itself.

- The DV incorporates additionally a Relay Valve which ensures consistent application and release timings of Brake Cylinder irrespective of the volumes at all times.

- A Brake Pipe Accelerator Valve with an Isolating Cock is connected to the Brake Pipe of the vehicle that provides rapid venting of the Brake Pipe Air. It comes to action during brake applications whenever the BP pressure is exhausted at an emergency rate and does not get activated during normal braking function up to full service position of the Driver's Brake Valve.

- Five Passenger Emergency Valves are provided inside the Coach of Chair Car to enable a passenger for operation towards stopping the train in case of an emergency. These Valves are connected to a single exhaust Valve that opens the Brake Pipe line to atmosphere whenever any of the Passenger Emergency Valve is operated. The passenger emergency alarm valves are provided limited switches and LED indication lamps to locate the particular valve which is actuated.

- Disc Brakes are mounted on each axle at outer ends inside the wheels instead of the conventional system of brake at wheel treads.

- UIC pattern Twin Brake Indicators are provided on each side of the coach that give a visible display of the condition of brakes on each bogie. During brake applied condition, they show a red indication and in release, a green indication. Chokes are provided in the pipeline to Brake Indicators to dampen the pressure surges and fluctuations.

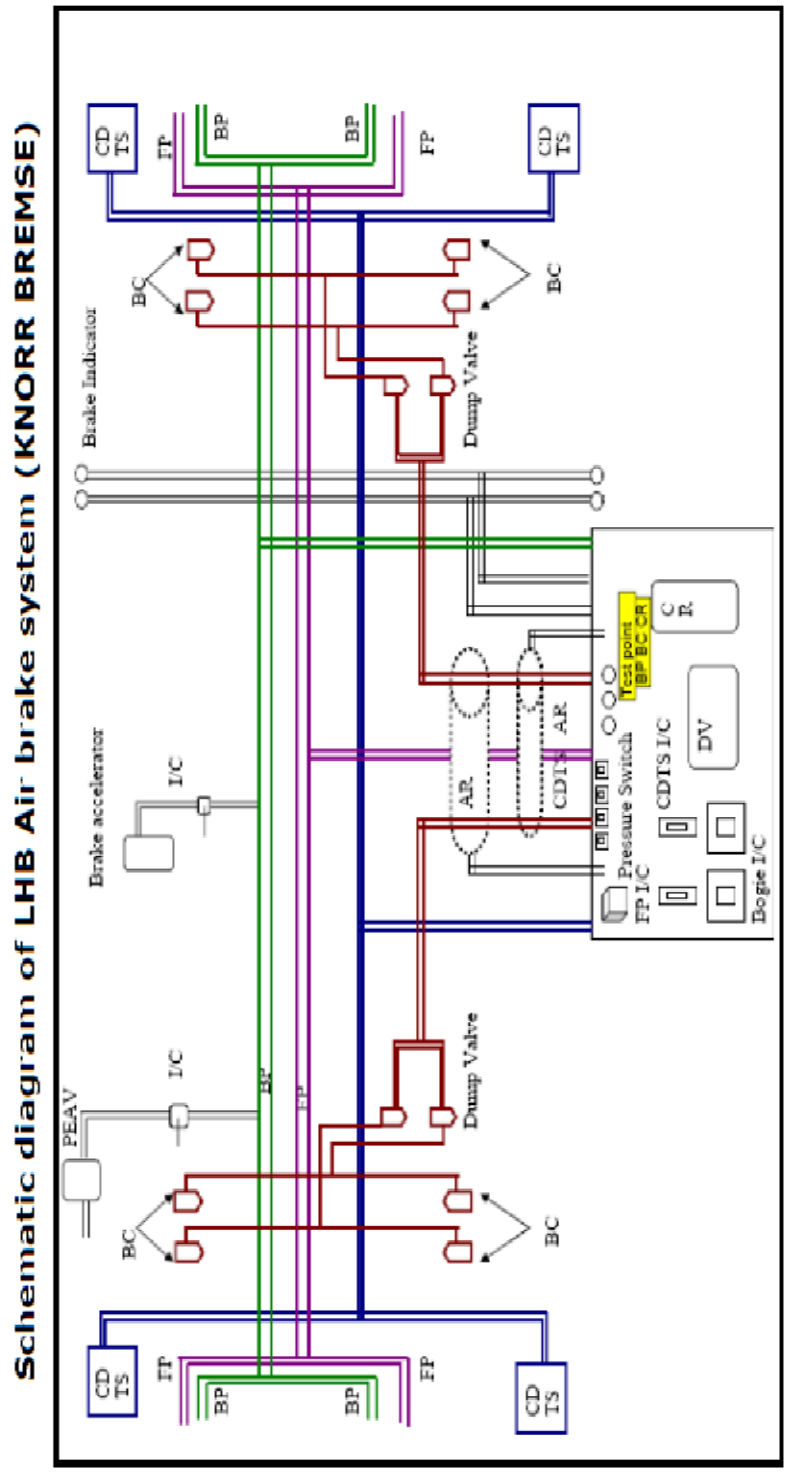
- Wheel Slide Protection developed with advanced microelectronics and use of microcomputers, enable the braking system to be operated at its optimum performance level by maximizing the use of available adhesion during braking of the train. The present problem of insufficient wheel / rail adhesion depending upon the co-efficient of friction available at wheel rail interface with a constant braking force leading to possible slide and consequent damage to wheel sets (flats) is avoided.

Comparison of LHB Air brake system with ICF Air brake system

LHB	ICF
Axle mounted Disc brake system	Bogie mounted disc brake system
No brake rigging for application of brakes	Brake rigging for application of brakes
Less thick SS pipes are used	Mild Steel pipes are used, now being retrofitted with SS pipes
Bite Type fittings are used (no threaded joints)	Threaded / flange joints are used
Wheel slide protection system to take care of wheel flattening	No such device to care of wheel flattening
No wheel wears due to braking.	Wheel wear due to brake block rubbing
Provision of test points in brake control panel to know the pressures of BP/FP/CR	No such test points to know the pressures of BP/FP/CR
DV with relay ensures brake application time and release.	DV has no relay to ensure the application time and release time
Centralised control of a coach through brake control panel	Centralised control is not available in ICF coaches
Isolation cocks are fitted in brake control panel for easy isolation	Isolation cocks are provided at various locations of Brake system
Brake accelerator for quick reduction of BP pressure in complete train set.	No such device in conventional ICF coaches
Brake Indicators are provided to give indication of braking/release	Brake indicators are not provided
QRV rod provided for easy release of CR pressure	Wire rope only provided for release of CR pressure
Simple mechanism provided for easy operation of PEASD and provided inside the coaches to avoid mishandling	Wire rope links are used for operation of PEASD and provided outside the coach.
FIBA device provided to know the Air spring failure	No such device in conventional ICF coaches (viz; DEMU,MEMU)

Chapter 3

LHB Air Brake Layout and Working



Operation of devices on a brake control panel:

Charging:
Initially the Brake Pipe pressure enters the Brake Panel through port and passes through a Centrifugal Air Strainer with Drain Cock. If the DV Isolating Cock mounted on the Valve Mounting Manifold assembly is opened, the BP pressure enters the Distributor Valve via a BP test point and charges the Control Reservoir 6 litres via a CR test point and the Auxiliary Reservoir - 125 litres. Externally the BP pressure charges into the BP Accelerator Valve through an Isolating Cock. The BP pressure also enters the Emergency Exhaust Valve inlet port and charges the Passenger Emergency Alarm Pilot Valves.

The Feed Pipe pressure enters the Brake panel through port and passes through a Air Strainer. Further, filtered air passes through a Pressure Switch assembly and a FP test point. If the Isolating Cock is opened, the air will charge into the Auxiliary Reservoir-125 litres to maintain continuous supply of compressed for brake application. The Feed Pipe air pressure opens the Check Valve and charges the Auxiliary Reservoir-125 litres. If the Isolating Cock is opened, the air will leave the panel through port of the Header which can be used for auxiliary equipment such as for door operation and flushing of toilets etc. The Feed Pipe pressure also enters the MR Port of Relay Valve and Distributor valve and acts as a Main Reservoir supply to these devices.

Brake Application:

When a Brake is applied, BP pressure is reduced in the system through the Driver's Brake Valve and BC pressure charges from the Distributor Valve into a Timing Volume Reservoir through a Choke and enters the signal port of the Relay Valve which in turn delivers the same pressure (1:1 pressure ratio). The output pressure from the Relay Valve leads to the Bogie Isolating Cocks BC1 and BC2. When the Cocks are opened the air leaves the panel through ports and goes to the Brake Actuators (BCs) through Dump Valves (D2) causing a brake application. The BC air also leaves the Panel through ports and goes to the Double Brake Indicators through a dia. 2 mm Choke. In this condition, window of the Brake Indicator shows a Red colour. When an emergency brake is applied, the BP Accelerator Valve vents the BP pressure through its exhaust port rapidly causing quicker brake application for the entire train. Whenever the Passenger Emergency Alarm Pilot Valve handle is pulled, the BP pressure vents at its exhaust port and causes the Emergency Exhaust Valve to open and thereby vent the BP pressure continuously to cause a brake application. Using the resetting key, the Passenger Emergency Pilot Valve can be reset to stop venting of BP air through the Emergency Exhaust Valve.

Brake Release:
When the Brake is released, BP pressure is again charged into the system thereby releasing the brakes. Venting the control BC pressure takes place through the DV and the actual BC pressure at the Relay Valve Exhaust port. After release, the windows of the Brake Indicators turn to Green, which indicate brake release.

WORKING PRINCIPLE OF AIR BRAKE SYSTEM:

When the Twin Pipe System with BP and FP lines on the coaches of the train is charged to 5.0 & 6.0 kg/cm² respectively by the locomotive, the air pressure in the air Brake Pipe connected to the Distributor Valves, controls the brake system of the coaches. To initiate and effect a brake application, the air pressure in the Brake Pipe is reduced and the Distributor Valve in each coach reacts to supply the Auxiliary Reservoir air pressure at a proportionate level as BC pressure to the Actuators. This BC pressure acts as a signal pressure to the large capacity Relay Valve. The Relay Valve in turn quickly supplies air pressure of the same intensity to the four Wheel Slide Dump Valves and finally reaches the two Brake Actuators provided one for each Brake Disc.

The force developed in each Brake Cylinder causes Piston movement and subsequently through linkage that force passes on to its Brake Calliper with Pads binds on the individual Brake Disc provided in each wheel set. The binding causes friction and retardation to wheel rotation. The force applied on the Disc and the brake effect will be proportional to the BC pressure supplied to the Brake Cylinder.

If wheel slip occurs on any wheel consequent to the brake force from the Disc not having been absorbed due to insufficient wheel / rail adhesion factors, a Sensor provided in axle end cover and Phonic Wheel fitted on one axle end of each wheel in combination feeds the signal to the Wheel Slide Protection Unit.

The WSP Unit in turn energizes through Dump Valve cabling / Connector instantly and operates the particular wheel slide Dump Valve (Solenoid Valve) provided in the Brake Cylinder circuit of the particular wheel. The Dump Valve gets opened and exhausts the BC pressure to atmosphere to minimise the braking effort for any given wheel / rail interface coefficient of friction. As soon as the wheel slide is stopped, the Sensor withdraws the electrical signal to WSP Unit and the later in turn automatically deactivates the Dump Valve to a close position. This allows restoration of BC pressure to the Brake Cylinder circuit due to the pressure-maintaining feature of DV. The Wheel Slide Protection is thus automatic in action and makes optimum use of adhesion during braking with resultant benefits of improved braking distance and prevention of continuous wheel slide / damages.

Reduction in the Brake Pipe air pressure can be caused by any one of the operations / events as under:

a) Driver's Automatic Brake Valve on the Locomotive
b) Guard's Brake Control in Brake Van
c) Pilot Valve for Passenger Emergency
d) Parting of train and disengagement of Brake Pipe

Of these, in respect of Driver's Automatic Valve operation only, it can provide a graduated brake application or release. For any Brake Pipe pressure held steadily below the normal running regime pressure of 5.0 kg/cm², brake application by way of Brake Cylinder pressure build up will be caused by theDV and will be held steadily at the proportionate level against normal leakage in the system.

Release of brake is affected by the movement of Driver's Automatic Brake Valve handle towards release position causing the BP pressure to increase towards regime pressure limit. The DV in turn causes the BC pressure to be withdrawn proportionately depending upon the increase of BP pressure. A reduced brake application or a complete release of brake can be provided depending upon the position of Brake Valve Handle selected.

Chapter 4

LHB Air Brake Components, Air Spring, FIBA

The Axle Mounted Disc Brake System is introduced in Mainline Passenger Stock for Indian Railways. This brake system equipment provided on the Alstom-LHB design coaches to meet the requirement for high-speed trains hauled by locomotives and permits the emergency braking for such trains to be within the stipulated limits when brakes are applied at a speed of 160 kmph.

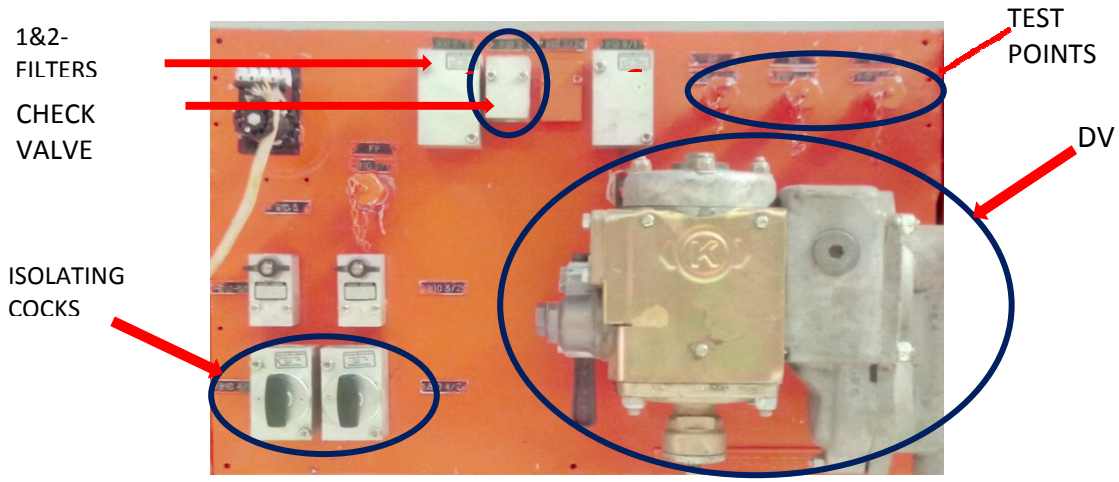
Brake system in the LHB coach broadly classified into 4 parts:

a) Brake Frame control (Panel) equipment
b) Brake Control equipment in the system layout
c) Bogie Brake Equipment
d) Wheel Slide Protection equipments
e) Flexi ball cable arrangement (Hand Brake)

a) Brake Frame control (Panel) equipment:

A Brake Panel with an Aluminium Slab manifold accommodates the Critical Valves of the brake system. This provision protects the Valves from the vulnerability of impact damages from ballast / flying debris during train operations, eliminate substantial piping work and facilitate maintenance by unit replacement. It also contains test points for checking the pressures of BP, AR, DV, BC and CR outputs at one location itself.

The DV incorporates additionally a Relay Valve which ensures consistent application and release timings of Brake Cylinder irrespective of the Volumes at all times.



S.No.	Air Brake Component Name	Qty./Coach
01	Distributor Valve	01
02	Control Reservoir-6litres	01
03	Air Filter	02
04	Test Point – BP, FP, CR & BC	04
05	Check Valve	02
06	Isolating Cocks For bogie isolation -2, FP-1, Toilets-1;	04
07	Pressure Tanks – (AR 125 Litres& CDTS 75 Litres)	02
08	Pressure Switch	01

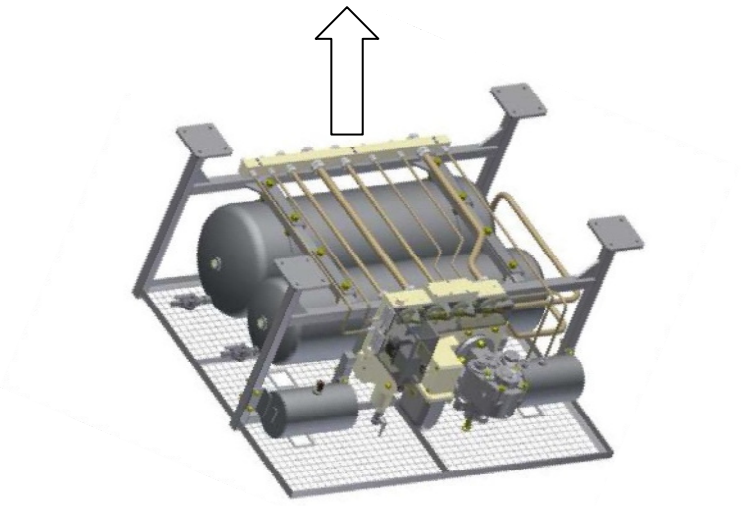
Connections to the Brake Frame (Panel):

There are 7 connections to the frame for Passenger Coach,

- Feed pipe
- Brake pipe
- Brake cylinder pressure -- bogie 1
- Brake cylinder pressure - bogie 2
- Indicating device - bogie 1
- Indicating device – bogie 2
- Auxiliary support pipe (for toilet)
- Support for Indicating device of handbrake

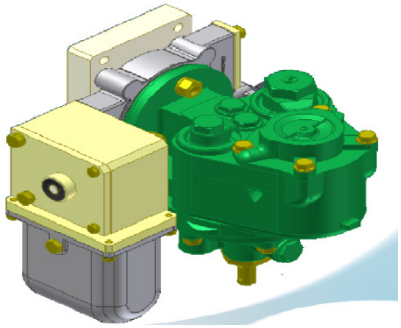
These connections from the container to car body are provided at the back plate fitted with single ferrule fittings.

Connections from coach to panel



Distributor valve:

It is similar to the conventional coach DV with slight design variation in Relay Valve and Max. Brake Cylinder Pressure is pre-set as 3.0Kg/Cm² for all LHB coaches and 3.8 Kg/Cm² for Double Decker

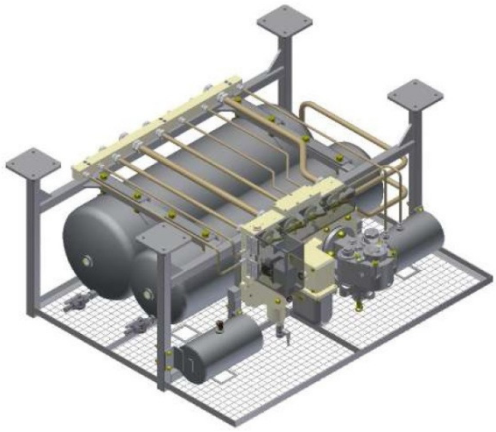


Pressure tanks (Air reservoirs

Main reservoir -One 125L for brake application (Protected by check valve)

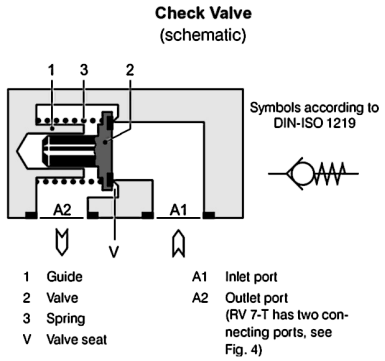
Auxiliary reservoir - One75L for toilets

Control reservoir - One 6L



Check valve

Check Valves are designed for mounting on manifold panels. When the air delivery is interrupted, the Check Valves prevent air which has already been delivered from flowing back out of reservoirs and pipes



Filters

The function of the filter is for protecting devices from contamination, malfunction and damage.

Technical data
Medium: Air
Maximum Pressure: 10 bar
Orifice cross-section: Approx. 280 mm^2 (Φ19 mm)
Filter Mesh: 0.1 mm
Connecting diameter: 19 mm

Test points

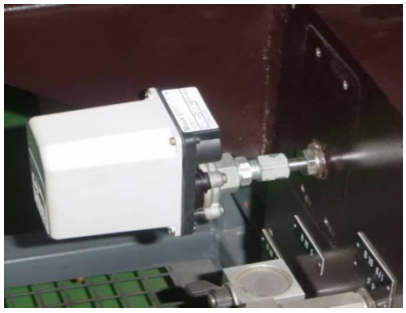
The test fitting is mounted on brake control units or installed in pipeline systems to test pressures in compressed air system.

Isolating cocks:
In brake control panel frame four isolating cocks are provided, out of which two are bogie isolation cocks and one FP isolation cock and one CDTS isolating cock

Type	Name of the cock	Colour of the cock	Position and aspect
Knorr Bremse	BC 1	Black	Vertical - Working Horizontal - Isolation
	BC 1		
	FP		
	CDTS		
	BC 1	Red	Vertical - Working Horizontal - Isolation
	BC 1		
	FP		
	CDTS		

Pressure Switch

This electro pneumatic governor utilized to switch 'ON' power supply to WSP system provided preset value of air pressure is available in the air brake pipe line.
This automatically put 'OFF' the WSP system, when coach is stationary & no pressure is available in the pipe line

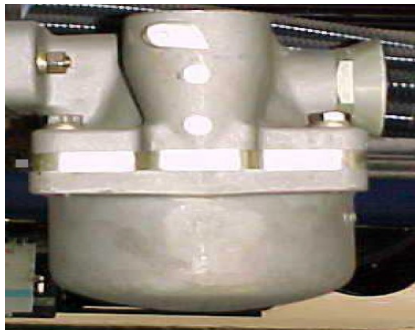


Brake Control equipment in the system layout

S.No.	Air Brake Component Name	Qty./Coach	Location
01	Brake Accelerator	01	Under Frame
02	Cut off angle cocks	04	
03	Brake Indicators	02	
04	Hose Pipes (BP & FP)	04	
05	Emergency Brake Valve (PEAV)	01	
06	½" Hose Connections – 500 mm	08	Bogie
07	½" Hose Connections – 600 mm	04	Under Frame
08	Emergency Brake pull-box	09	Passenger Coupe

Brake Accelerator:

This is directly connected to Brake Pipe and Whenever Emergency Brakes are applied by loco pilot beyond full service application, it reduces BP drastically by creating local exhaust on each coach

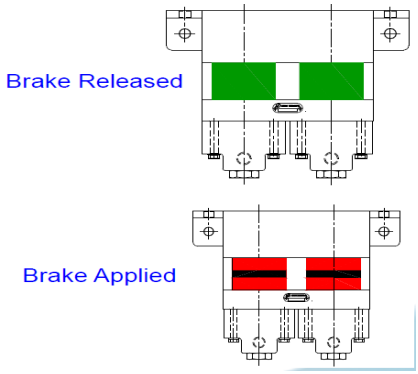


Emergency Brake Valve (PEAV)

This comes into action to reduce BP whenever emergency alarm pull box is pulled by the passenger for application of Train Brakes

Brake Indicators

Pneumatically actuated by brake cylinder pressure and turns on to RED from GREEN during brake application for easy identification from outside that the brakes are applied on the coach.



Emergency Brake pull-box

This is pulled by the passenger during emergencies to stop the train and to draw the attention of loco pilot.

Bogie Brake Equipment

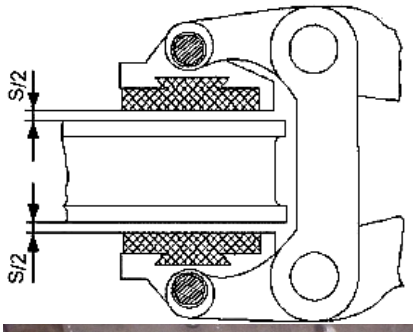
S.No.	Air Brake Component Name	Qty./Coach
01	Brake Cylinders	08
02	Brake Calipers with pads	08
03	Brake Discs	08

Brake Cylinders

Brake cylinders with automatic slack adjustment are used in LHB coaches.
No manual adjustment to make after brake pad replacement.
Piston stroke: 21 mm (max)
Slack capacity: 160mm (min)
Cylinder size: Dia. 10 inches
Max BC pressure: 3.0 kg/cm^2 (except double decker)

Brake Calipers with pads

Brake Caliper connected to the brake cylinder and the brake shoes with snap lock gates. The brake caliper units are held in the vehicle bogies by a three – point-mounting arrangement.
Lever Ratio: 2.17 for all, except 2.48 for ACCN/SG and Power car

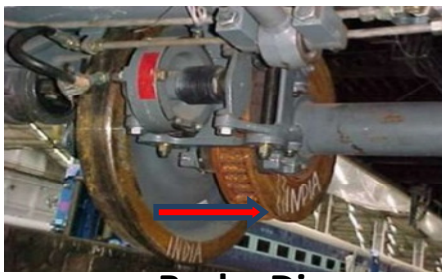


Brake pads

Brake pads (Composite type): -35mm thick and 200 Cm^2
Quantity per coach: 32 Nos. (16 LH - 16 RH)
(16 on each bogie-2 on each caliper)
Wear limit -28mm max.
Condemn Thickness is 7 mm.

Brake Discs

The axle mounted brake disc consists of a gray cast iron friction ring and a cast steel hub, connected by means of radically arranged elastic resilient sleeves which are secured in the hub by means of hexagon screws.
The crosswise cooling ribs carry off the heat and serve simultaneously to maintain a thermal balance within the friction rings.
Quantity per coach:- - 8 Nos (two per axle)
Disc dimensions: -640X110
Material: - Grey cast iron



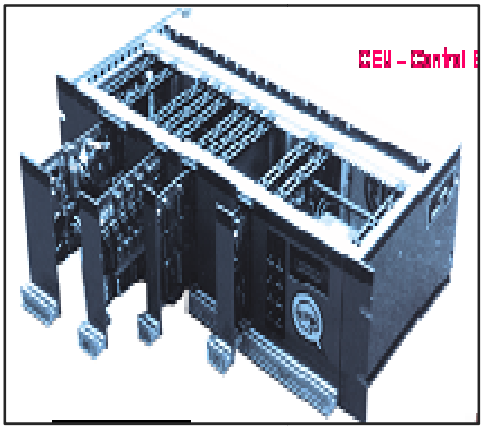
Brake Disc

Wheel Slide Protection equipments

S.No.	Air Brake Component Name	Qty./Coach
01	Microprocessor Control Unit	01
02	Speed Sensors/Pulse Generators	04
03	Anti Skid Valves/Dump Valves	04
04	Pressure Switch	01
05	Phonic Wheel	04

Microprocessor Control Unit

Microprocessor is the heart of the WSP system. This gathers the signals from phonic wheel & speed sensors, evaluates the vehicle speed. Moreover, it monitors & bridges the sharp drop of speed of a particular axle/wheel, enabling the dump valve to control/adjust the brake cylinder pressure.



Speed Sensor

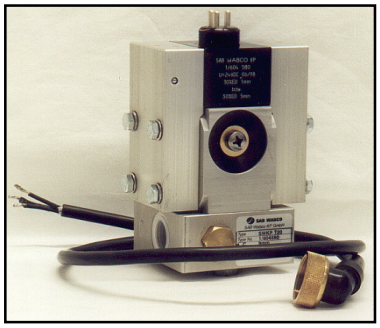
The speed sensors are fixed on one end of the axle box cover with the help of two bolts. The main function of speed sensor is to pick up the signals with the rotation of phonic wheel mounted on axle end & convey to microprocessor.

The air gap between the rotating gear (Phonic wheel) & speed sensors probe should be

Knorr Bremse = 0.4 to 1.4 mm
Faiveley = 1.5 $\pm$ 0.5 mm

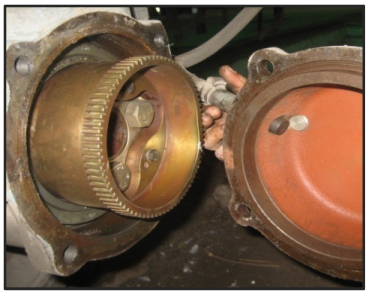
Anti Skid Valves/Dump Valves

A dump valve is provided for each axle of the vehicle. These dump valves are a type of solenoid valves, connected with the air pressure line of brake cylinder. Dump valve/antiskid valve should be fitted close to the brake cylinders. These dump valves allow to deplete the air available in brake cylinder line during brake application based on the signals from WSP microprocessor.



Phonic wheel

A phonic wheel is installed on one end of each axle. The phonic wheel is a toothed wheel (gear type). The purpose of this toothed wheel is to alter the internal inductance of the adjacent sensor. The change in internal inductance is evaluated as axle speed of various axles on a coach.



Flexi ball cable arrangement (Hand Brake) Equipment

Total two brake cylinders are connected with this hand brake arrangement in Power Cars. For each brake cylinder two hand brake cables are connected and these will be connected to hand brake wheel in the guard compartment.

S.No.	Air Brake Component Name	Qty./Coach
01	Hand brake indicators (One on side of coach)	02
02	Check valve (In feed pipe)	01
03	6 lt. Air cylinder	01
04	Roller lower valve	01
05	Flexi ball cables of suitable lengths.	02

Air Spring:

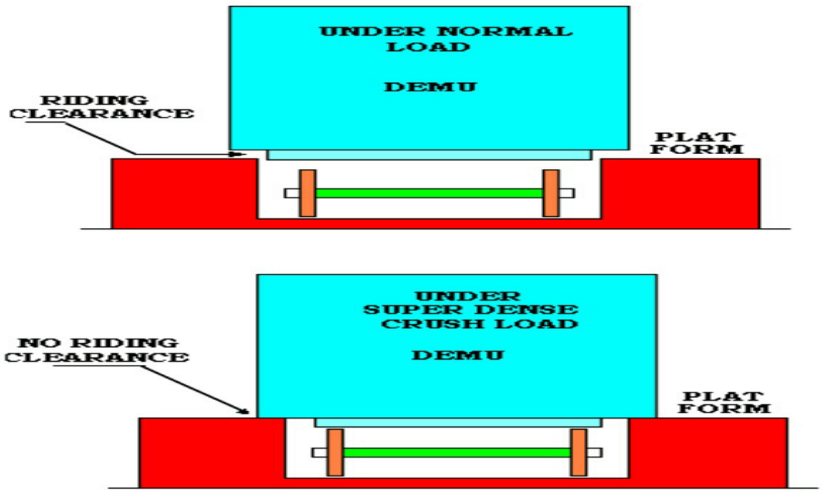
Air Spring is a height-controlled Load leveling Suspension Device which utilizes air properties for cushioning effect and damping. Air spring replaces conventional coil springs in secondary suspension. With increase in load and speed the existing coil spring ICF type bogie suspension of coaches, the bogies clearance basically meant for absorbing dynamic movement of the coach, just vanish resulting into severe hitting between various bogie components. This leads to premature failure of bogie components and poor riding behaviour of the coach. To overcome this problem, air (pneumatic) suspension (air spring) at secondary stage has been taken up with optimized values of stiffness and damping characteristics. Air Springs are introduced in high carrying capacity Coaches viz. **MMTS / DEMU / LHB / Hybrid** coaches on Indian Railways

ADVANTAGES OF AIR SUSPENSION

- BSS Hangers & Equalising stays of ICF bogie are eliminated.
- Compensating rings are not required for buffer height adjustment.
- Constant floor height of coach
- Excellent ride comfort
- Capable to sustain Super Dense Crush Loads of suburban traffic
- Safe running of train
- Virtually Constant natural frequency from tare to full loads
- Integral input signal for load dependent braking and acceleration
- Isolation of structure borne noise
- Improved reliability, reduced maintenance
- High durability

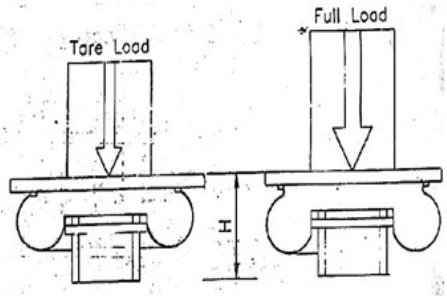
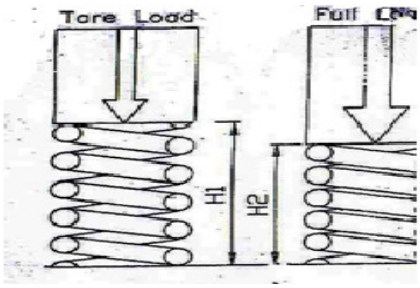
Need for Air Suspension in IR

- To maintain constant buffer height during super dense crush loading.
- Improves riding quality (Riding index 2.72).



DEMU without Air Spring

Air Springs vis-a-vis Steel Coil Springs

Air Spring	Coil Spring
Maintains constant Buffer height	Buffer height reduces with increased load
Higher stiffness with greater load	Linear Stiffness characteristics
Riding Index: 2.72	Riding Index: 3.37
Superior ride comfort	Moderate ride comfort
Less structural noise	More structural noise
Higher speed potential	Limited speed potential
Provision of Emergency Rubber Spring	No such provision
	

Induction of Air spring in IR

Trail run by RDSO	2001
ICF design coaches made by RCF	2007
Hybrid Coaches	2007
LHB FIAT Bogie Coaches	2008
LHB Hot Buffet Car	2008
LHB Double Decker	2010
Generator car	2011

Parts of Air suspension system per coach

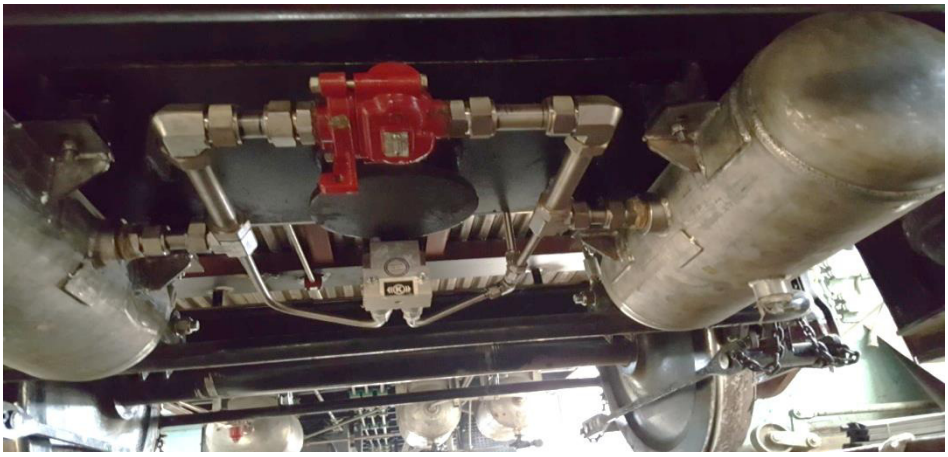
SNO	Component	Qty.
1	Air spring	04 Nos
2	Main reservoir(150 lts)	01 No
3	Auxiliary reservoirs (20 / 40 / 60 lts)	04 Nos
4	Levelling valve	04 Nos
5	Installation lever	04 Nos
6	Duplex check valve	02 No
7	Bogie suspension Isolating Cock	02 Nos
8	Coach suspension Isolating Cock	01 o

1. **Air Spring**
   The main parts of Air Spring are:
   - Top Plate
   - Bid Skirt
   - Rubber Bellow
   - Emergency Rubber Spring
   - Base Plate
2. **Main Reservoir**

It is charged with 6 kg/cm² from FP main pipe line. Main Reservoir feeds Air bellows through levelling valve. Its capacity is 150 lts.

3. **Auxiliary Reservoirs (AR)**

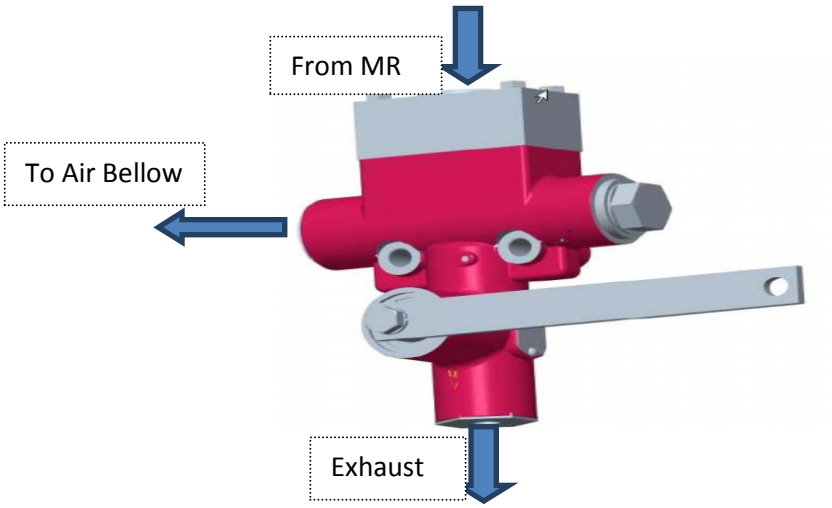
Auxiliary reservoirs two for each bogie continuously fed compressed air into the Air Springs.



Auxiliary reservoirs (20/40lts)

4. Leveling valve

It is connected to Top bolster and moves along with air bellow. It regulates the supply of air to the air bellow so as to maintain predefined buffer height at all variable loads.



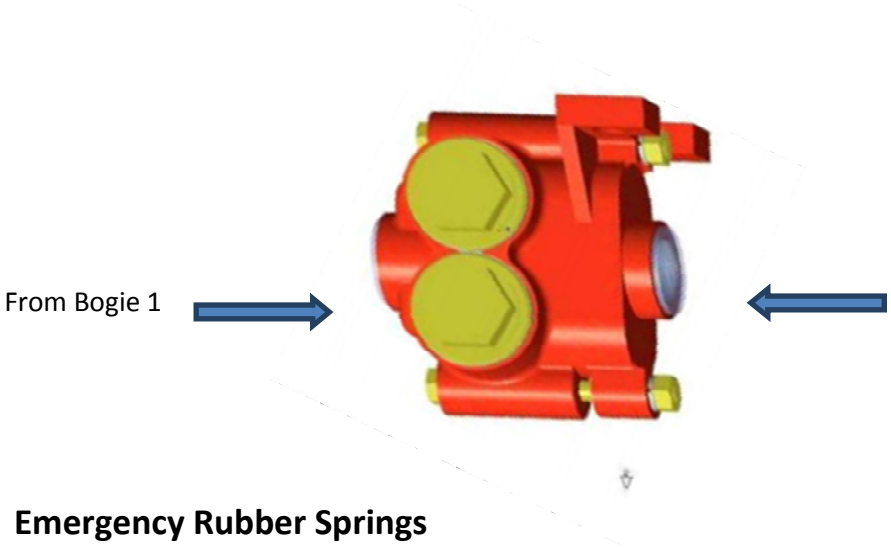
5. Installation lever

It connects leveling valve and lower spring beam. Installing lever has ball and socket joints at both ends. It avoids unnecessary rotation of levelling valve lever.

6. Duplex Check Valve

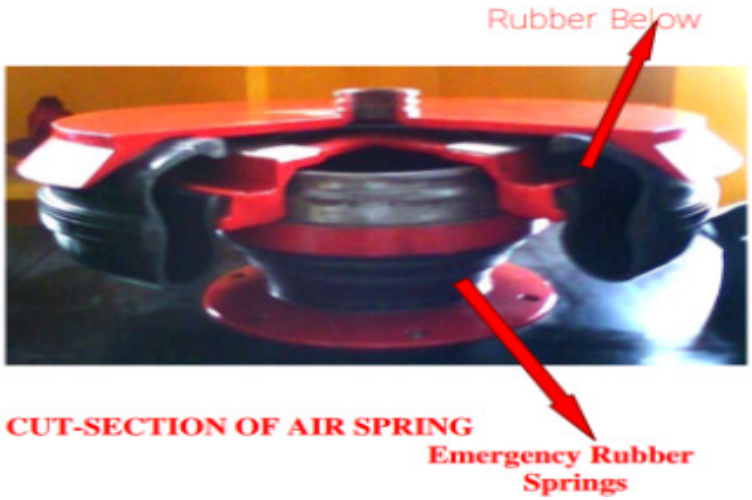
- It is fitted between two air springs of a bogie.
- It ensures levelling of two air springs.
- When a burst air spring, this valve ensure that no severe tilt will occurs by venting the air into atmosphere.

- Duplex Check Valve is fitted in the connecting pipe line between two Air Springs in a Bogie.It permits air flow into air bellows in either direction when ever pressure differential is greater or equal to 1.5±0.12 kg/cm

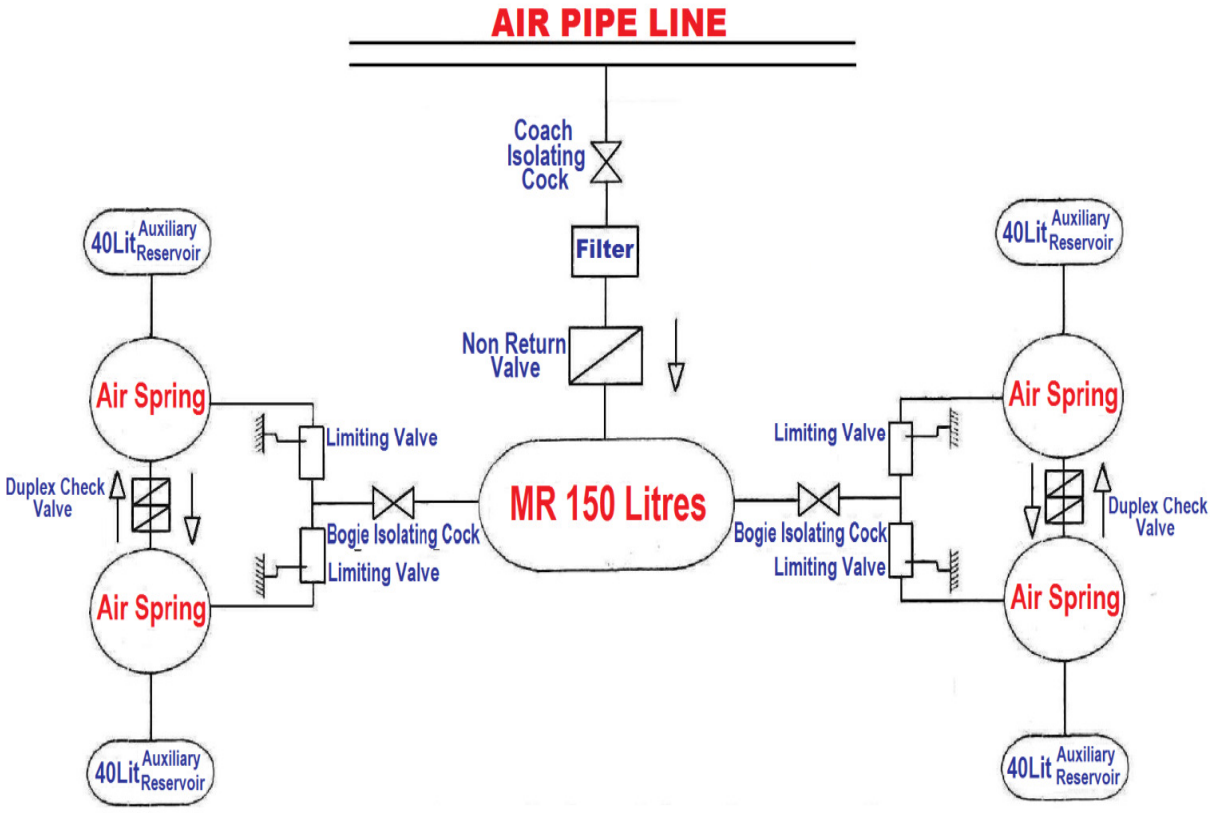


Emergency Rubber Springs

Air spring has inbuilt emergency rubber spring.When air spring fails enroute, the load comes on emergency rubber spring.

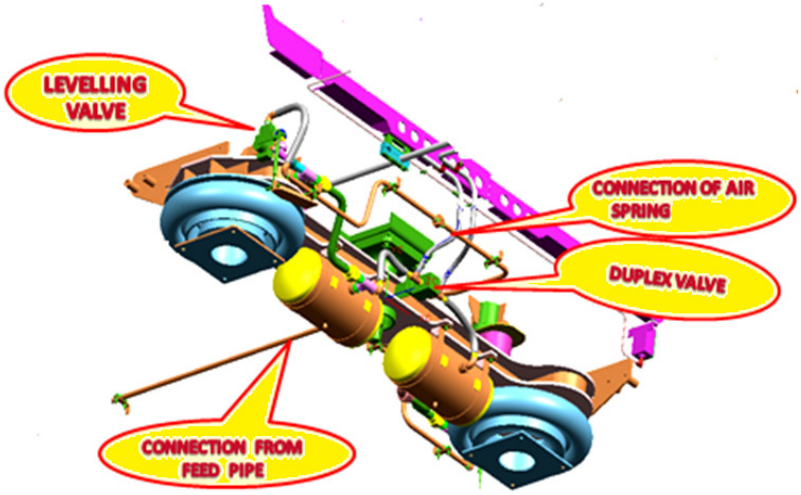


Schematic diagram of Air suspension



SCHEMATIC DIAGRAM OF AIR SUSPENSION EQUIPMENTS

Air suspension system arrangement

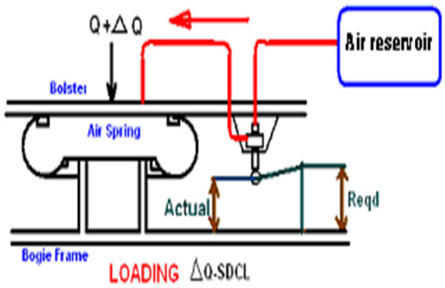


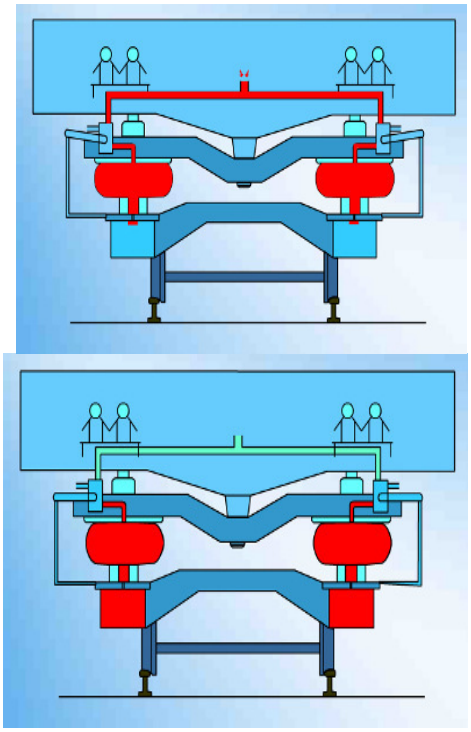
Air Spring working principle:

In this system the properties of air are used for cushioning effect (springiness). Enclosed pressurized air in a predefined chamber called air spring, provides various suspension characteristics including damping. Air spring is height controlled load levelling suspension device. With changing loads air spring reacts initially by changing the distance between air spring supports and vehicle body. The leveling valve is, in turn, actuated, either by getting the compressed air pressure to the air spring or releasing air pressure from it to the atmosphere. This process continues until original height is restore

1. Passengers occupation increases

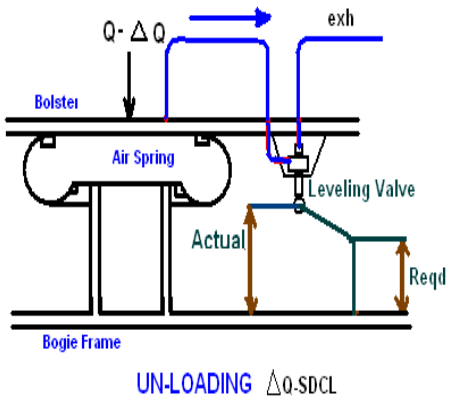
When load increases, to maintain designed buffer height excess air is charged to air bellow through levelling valve.

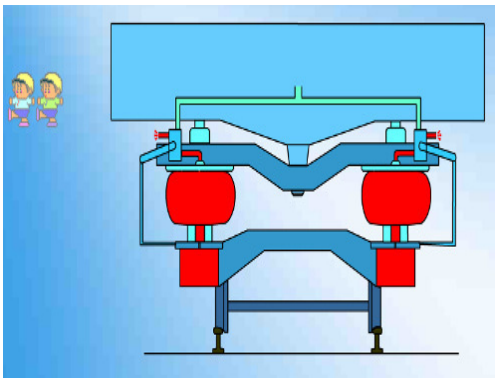


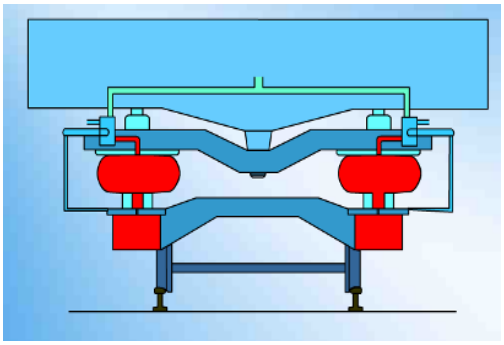


2. Passengers' occupation decreases

When load decreases, to maintain designed buffer height air from air bellow is exhausted through levelling valve







3. Uneven Load distribution in the coach

Levelling valve lever rotates down due to passengers' occupation on one side. Levelling valve allows pressurised air from MR to Air bellow and designed buffer height is restored

4. When Air bellow bursts

- When air bellow bursts, air leaks and bellow height reduces, levelling valve lever moves down.
- Air flows from MR to air bellows continuously
- When pressure difference between two Air bellows is more than 1.5kg/cm², Duplex Check Valve is activated and air from intact air bellow is also connected to atmosphere through burst air bellow.
- Bolster on both sides will be resting on emergency rubber springs.
- Close the bogie isolation cock, and then train speed to be restricted to 60 kmph.

FIBA – Failure Indication and Brake Application

Introduction:

A four–point air suspension system is used in coaching stock for better riding comfort. Apart from the ride quality, the air spring system is provided with control equipment to ensure a constant height of the coupler from rail level irrespective of the load carried by the coach, which indirectly benefits the passenger by providing a constant entry height from the platform into the coach.

If one of the four bellows gets deflated due to a rupture, the coach may tilt and might further lead to untoward incidences. Though the control system has a built-in safety feature (duplex check valve) to equalize the pressure in the adjacent bellows on the same bogie, still the inclination of the coach may warrant a cautious running from the time. Hence, there is a requirement for a system that could indicate a bellow burst situation and apply brakes to avoid any mishaps through the Brake pipe dropping so that Loco Pilot attention can be drawn for investigation.

Failure Indication & Brake Application (FIBA) is a device which senses the pressure drop in any bellow of coach beyond a limit and initiates to drop brake pipe pressure, resulting in application of brakes leading to ultimate stopping of the train.

Objectives of FIBA:

1. To provide a positive indication to the driver and the crew of the train by whistlingsoundand indication on both sides of the train through indicators on that particular coach.
2. To initiate the dropping of brake pipe pressure, resulting in application of brakes leading to ultimate stopping of the trainin case of Air Spring Failure.

WORKING PRINCIPLE:

The working principle of our FIBA device is absolute pressure system. The equipment is designed to sense the bellow pressure on continuous basis and actuate dropping of brake pipe pressure when the pressure in the bellows of the concerned bogie falls below 1 kg/cm^2, resulting in application of brakes in the train and ultimate stopping of the train.
In case of bellow burst, it gives a red indication through indicators provided with FIBA device on each side of the coach along with the hissing sound of air. The system is provided with isolating cocks to stop the discharge of brake pipe pressure to enable the train to run at restricted speed upto the destination.

Figure 1: FIBA Panel

Constructional Details:

FIBA device works on pure pneumatic circuit. One device works for one bogie; hence each coach is fitted with two nos. of FIBA devices. Hence, both the bellows of the same bogie are monitored by one FIBA device.

FIBA device has 04 ports, 01 no. for the connection from BP line, 02 nos. for connection from bellow pressure and 01 common port for connection from brake indicators (02 nos. brake indicators connected with one FIBA device) for visual signal. Branch pipes coming from BP pipe line and bellows are connected to ports on device via ¾" flexible hoses. Isolating cock with vent has been provided between each branch pipe and flexible hose. Pipes coming from Brake indicators are connected to FIBA device via 3/8" flexible hose.

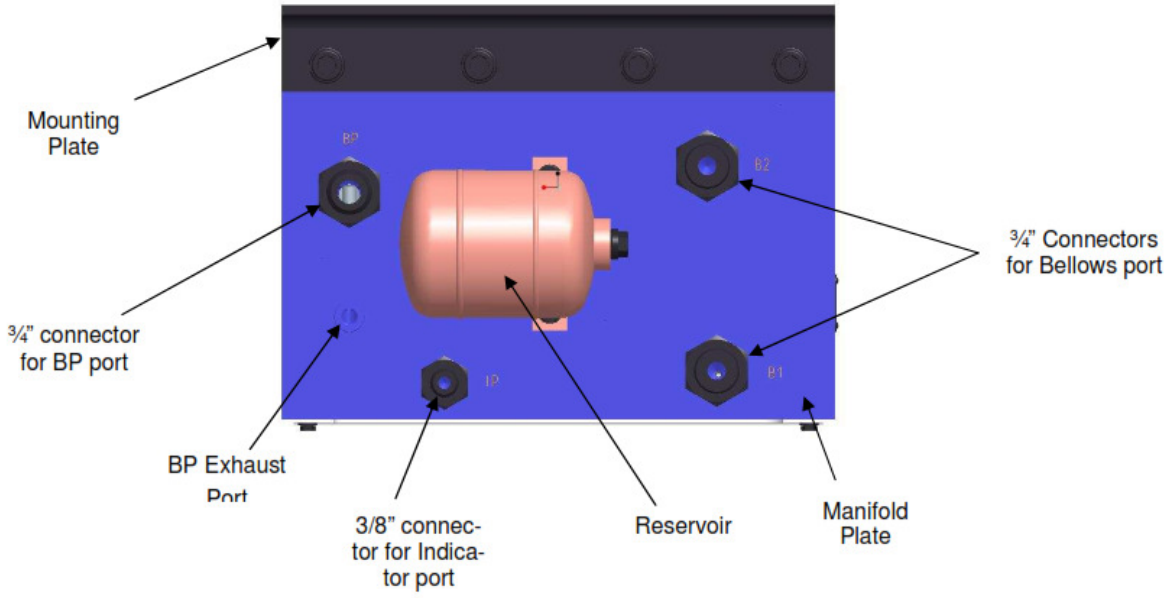


Figure 4: connections to FIBA mounting panel

SN	Part List For FIBA Device	Qty / coach
1	Air spring failure indication cum	02
2	Brake Application Device (FIBA)	04
3	Indicators Isolating Cock with Vent OLP 20 NB	04
4	Isolating Cock without Vent OLPNB	02
5	Flexible Hose 3/8" x 500	06
6	Flexible Hose 3/4" x 550	02
7	SS Nyloc Nut M10	08
8	SS Hex. Head Screw M10x35	08
9	SS Washer A10.5	08
10	Split pin – 4 x 32	06
11	SS Nyloc Nut M16	06
12	SS Hex Head Screw M16x45	06

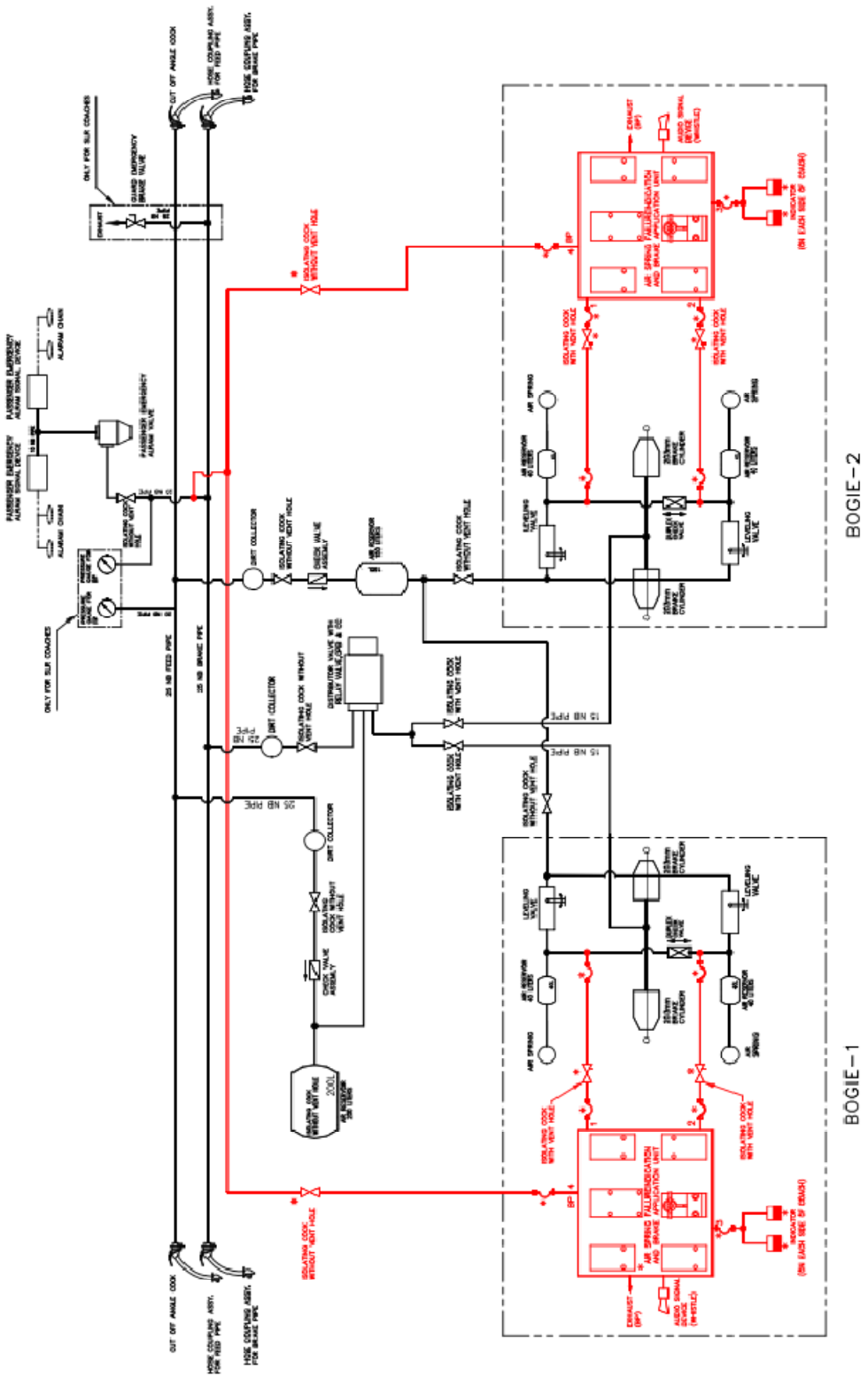


Figure 2: Complete Schematic Layout of FIBA on a Coach

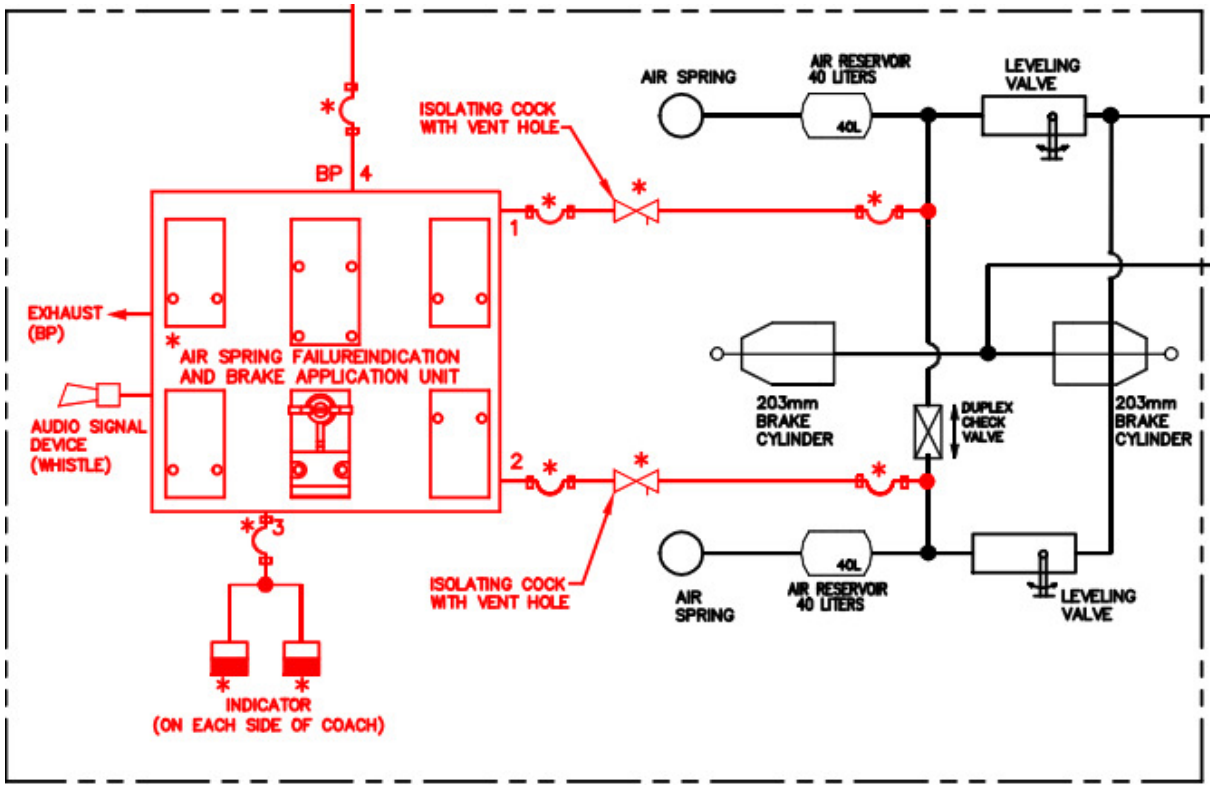
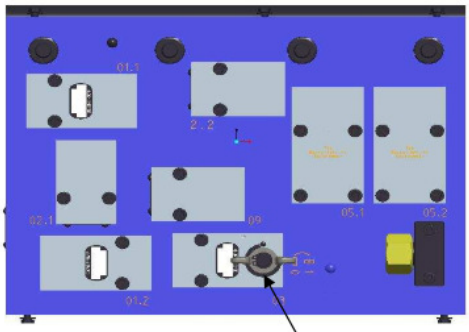
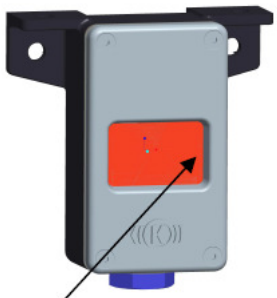


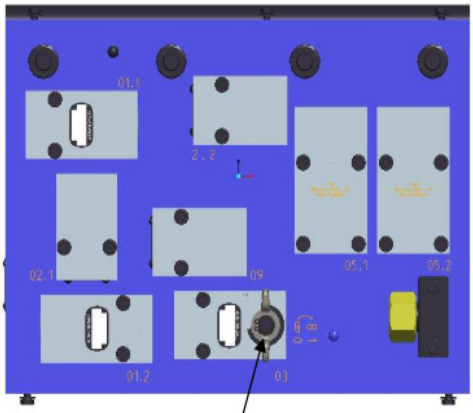
Figure 3: Schematic Layout of FIBA for individual bogie



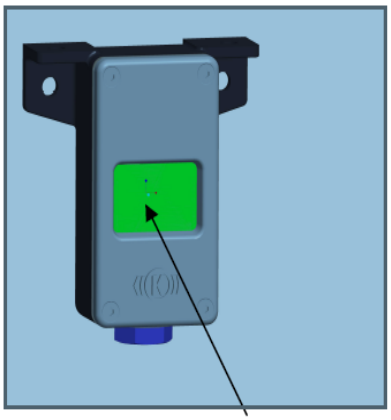
Isolating cock in open condition



Indicators are Red



Isolating cock in close condition



Indicators are Green

Maintenance Instructions for FIBA Device

(Ref: RDSO Letter No.SV.AS.FIBA dt.01/11.06.2018)

1. **During Train Examination & Maintenance:-**

Following tests and checks of FIBA devices shall be done during various maintenance schedules carried out in Workshops & Maintenance depots

S. No.	Maintenance/checks/tests to be carried out	During Primary/Secondary Maintenance	Schedule "A"	Schedule "B:	Schedule "C"/IOH/POH
1	Condition of mounting bracket, mounting bracket bolts and fasteners, FIBA device cover, loose fitting, condition of isolating cocks, Release valves and release valve handles, unusual leakages from FIBA device or joints and pipelines to be checked and if found defective to be attended.	YES	YES	YES	YES
2.	Testing of functional behaviour as per Format "A"	YES (01 coach during Primary Maintenance)	YES (10% or 02 coaches at Primary End)	YES (10% or 02 coaches at Primary End)	--
3.	Testing of functional behaviour as per Format "A"	--	--	--	YES (100% coaches in Sick lines/Workshops)

2. **During Rolling-In/ Rolling-Out Examinations:**

During Rolling-in /Rolling-out examinations of trains, the following items of FIBA devices should be checked:

i. Indicators colour, i.e. Red or Green to be checked. In any case any indicator of FIBA device found Red, FIBA device of same should be examined thoroughly and suitable action to be taken.

ii. Hissing sound or any major leakage from FIBA device to be observed.

iii. Any hanging or loose part unusual sound from FIBA device or pipelines to be observed.

3. Action taken during actuation of FIBA Device

Following shall occur in actuated FIBA device:

i. Both indicators of FIBA device of same bogie will turn Rrd
ii. Hissing sound will start from exhaust port of FIBA device.
iii. Brake will apply in train

Following shall occur in actuated FIBA device:

a) Enroute

i. Identify the coach in which FIBA device is actuated.
ii. Note down the coach particulars and location of actuated FIBA device. Brakes will release in brake release position of the train. Hissing sound will stop.
iii. Close the isolating cock with vent feature provided in FIBA device and Air springs and drain the air.
iv. Close both isolating Cock with vent feature provided between FIBA device and air springs and drain the air. FIBA device will be isolated from air springs and drain the air. FIBA device will be isolated from air spring. However, Indicators of FIBA device may or may not turn to green
Pull the resetting keys provided on FIBA device. Indicators of FIBA device will turn to green.
v. Isolate the air springs of affected coach.
vi. Start the train and proceedupto next C&W point or destination with maximum speed of 60 KMPH.

At the next C&W point, C&W staff will examine the affected coach and check for the failure of air spring. In case of failure of spring is confirmed, detach the coach or rectify the air spring or coach may be allowed upto next suitable point available for repair or upto destination at restricted speed.
In case air spring is found intact and FIBA device is malfunctioning, the FIBA device may be isolated & air springs in working condition. Train may be allowed to run with normal speed.

b) At C&W point

i. Identify the coach in which FIBA device is actuated.
ii. Note down the coach particulars and location of the FIBA device.
iii. Examine the affected coach and check for the failure of air spring. In case failure of air spring is confirmed, FIBA device and and air springs of affected coach may be isolated.
iv. Detach the coach for necessary repairs of air spring or rectify the air spring.
v. Reset the FIBA device.
vi. Test the functionality of FIBA device as per enclosed as per Format-A.

FORMAT - A

ONVEHICLE TEST FORMAT FOR FIBA DEVICE:

Depot/ Div/ Rly/PU…… date of testing ……coach No……

POH/mfg. details (coach)…… Return date …….. Year built ……..

S.no.	Test and testing procedure	Standard	Results obtained			
			Bogie no. …….. S.no. Of FIBA device : Make Mfg. Date:		**Bogie no. …….. S.no. Of FIBA device : Make Mfg. Date:**	
			Air spring-1	Air spring-3	Air spring -2	Air spring-4
1	**Initial charging :** 1. Charge the FP at 6.0 kg/cm2 and BP at 5.0. kg/cm2 2. Ensure the charging of air springs with the help of leveling valve lever position.	FP=6+ or – 0.1 kg/cm2 BP=5+or -0.1kg/cm2 Leveling valve lever should be in horizontal position				
2	**Leak detection :** Check for any leakage in entire system. Any leakage found in FIBA device or pipe lines should be attended.	No leakage				
3	**Functional test:** Charge the air springs on tare condition of the coach and BP at 5.0 kg/cm2. Open the ½" drain cock of 40L auxiliary reservoir of one side air spring.	i. FIBA device of the relevant bogie should actuate. ii. Brakes should apply in the entire coach. iii. Both indicators of same bogie should be red. Indicators of the other bogie should show green. iv. Whistling/ hissing sound should blow.				
4	**Brake pipe isolation:** Close the isolating cock of the BP line of the actuated FIBA device.	Brake should release in the entire coach.				
5	**Suppression of indicator:** Close the both isolating cocks with vent feature and pull the resetting keys if provided.	Both indicator of the same bogie should turn to green from red. Indicators of other bogie should remain green.				

- **During new fitment of FIBA device in PUs and Railways**
  - **i.** All the pipe arrangement and fitment shall be done as per RCF respective drawing.
  - **ii.** Functionality test of FIBA device during new fitment in coaches shall be done as per FORMAT –B.

FORMAT - B

ONVEHICLE TEST FORMAT FOR FIBA DEVICE:

Depot/ Div/ Rly/PU…… date of testing ……coach no……

POH/mfg. details (coach)…… Return date …….. Year built

S.no.	Test and testing procedure	Standard	Results obtained			
			Bogie no. …….. S.no. Of FIBA device : Make Mfg. Date:		**Bogie no. …….. S.no. Of FIBA device : Make Mfg. Date:**	
			Air spring-1	Air spring-3	Air spring -2	Air spring-4
1	**Initial charging :** 3. Charge the FP at 6.0 kg/cm2 and BP at 5.0. kg/cm2 4. Ensure the charging of air springs with the help of leveling valve lever position.	FP=6+ or – 0.1 kg/cm2 BP=5+or -0.1kg/cm2 Leveling valve lever should be in horizontal position				
2	**Leak detection :** Check for any leakage in entire system. Any leakage found in FIBA device or pipe lines should be attended.	No leakage				
3	**Functional test:** Charge the air springs on tare condition of the coach and BP at 5.0 kg/cm2. Open the ½" drain cock of 40L auxiliary reservoir of one side air spring.	i. FIBA device of the relevant bogie should actuate. ii. Brakes should apply in the entire coach. iii. Both indicators of same bogie should be red. Indicators of the other bogie should show green. iv. Whistling/ hissing sound should blow.				
4	**Brake pipe isolation:** Close the isolating cock of the BP line of the actuated FIBA device.	Brake should release in the entire coach.				
5	**Suppression of indicator:** Close the both isolating cocks with vent feature and pull the resetting keys if provided.	Both indicator of the same bogie should turn to green from red. Indicators of other bogie should remain green.				
6	**Brake pipe variation test:** Drop BP pressure from 5.0 kg/cm2 to zero.	i. FIBA device should not actuate. ii. Brakes should apply. iii. No FIBA indicator should turn to red. iv. No whistling/hissing sound				
7	Reception of test for testing of FIBA device for remaining 03 Air springs of the coach.	Repeat the above procedures for the testing of the remaining 03 Air springs accordingly and note down the readings in relevant column.				

Chapter 5

Maintenance Schedules of LHB Stock with respect to Air Brake

Coaching Depot Schedules

Schedule D1 : Trip/Weekly at nominated primary maintenance depot

Schedule D2 : Monthly ± 3 days

Schedule D3 : Half Yearly ± 15 days

S.No	**Particulars**	**Schedule**		
		D1 Trip/ Weekly	**D2 Monthly**	**D3 Half Yearly**
	Frequency of Examination	**7 days ± 1day**	**30±3 days**	**SixMonth±15 days**
	Maintenance to be done at	On rake at nominated primary depot	On rake at nominated primary depot	Sick line at nominated primary depot
Check functionality of brake equipment and Hand brake equipment.		√	√	√
Perform a visual check on Brake cylinders/ brake levers and Hand brake equipment for damage, cracks and corrosion.		√	√	√
Perform a functional test on pneumatic brake system. Make sure that no leaks are present.		√	√	√
Perform a visual check on hoses.		√	√	√
Visually inspect steel piping for cracks/ damages/ ballast hitting. Repair/ replace as necessary.		√	√	√
Perform a visual check on brake discs. Verify absence of axial movement along the axle.		√	√	√
Verify that the clearance between each pad and disc surface is 1-1.5 mm.		-	√	√
Pressure Air Equipment		D1	D2	D3
Safety valve check for correct function.		√	√	√
Dry out air filter		-	√	√
Clean air filter		-	√	√
Clean airline filter		-	√	√
Drain air tanks.		√	√	√

SHOP SCHEDULES

Shop Schedule I : 18 months / 6 lakh Kms whichever is earlier
Shop Schedule II : 36 months / 12 lakh Kms whichever is earlier
Shop Schedule III : 72 months / 24 lakh Kms whichever is earlier

Shop Schedule I

Perform functional test of the Air Brake system components:

- Distributor valve
- Check valve
- Isolating cocks/angle cocks
- Filters, indicators, test fittings.
- Emergency brake valve & pull box
- Brake cylinders
- WSP Equipment

Brake gear pins and other bogie pins must be examined for

- Wear and re-greasing.
- Replace, if necessary.

· Examine BP/FP couplings and hoses. Replace, if necessary.

· Examine the Brake calipers and Brake pads for wear and damages.

· Check the functioning of hand brake equipment. Replace the defective components.

Shop Schedule II

Perform overhauling & function test of Air Brake System Components

- Distributor valve
- Check valve
- Isolating cocks/angle cocks
- Filters, indicators, test fittings.
- Emergency brake valve & pull box
- Brake cylinders
- WSP Equipment
- Replace Air Brake Hoses

Examine the Brake calipers and Brake pads for wear and damages, Replace if necessary

Check the functioning of hand brake equipment. Replace the defective components.

Shop Schedule III

All items of Shop Schedule II
Overhauling of brake cylinder

PERIODICAL INSPECTION OF AIR SPRINGS SYSTEM ON LHB COACHES

Schedule of Inspection	Inspection on Air Spring System	Inspection Site
Schedule-D1	• Visual check: General conditions which includes any external damages, air leakage, infringement of any fittings, etc. • Draining of 150-liter air reservoir of air spring • Check the position of isolating cock and drain cock, these should be on and off position respectively. Draining of 60-liter reservoir. • Cleaning of leveling valve filter as per manufacturer's manual.	Pit line
Schedule – D2	• As in Schedule –D1 • Checking of installation lever with inflated air spring for normal function, tightening of installation lever nuts and protection screen nuts, tightening of bracket of all flexible hoses. • Cleaning of air filter of 150-liter reservoir.	Pit line
Schedule – D3	• As in Schedule –D2 & • Thorough checking of air spring, bulging of bellow, air leakage. • Air suspension pipe leakage check by using soap water. • Removing dust mud & oil deposit if any, on air spring and control equipment. • Thorough checking of square platform provided on y- frame of bogie for any crack and deformation. • Tightening of air spring bottom plate bolts and nuts. • Measurement of bogie clearances related to air spring.	Sick line
IOH/POH	• As in Schedule – D3 and • Through visual check of air spring after dismantling. • Remove all valves and carry out external cleaning, overhauling and function test should be done as given in maintenance manual supplied by respective vendors. • Checking securing arrangement of steel pipeline. • Leakage test of air springs. • Installation lever adjustment. • Lateral damper condition should be checked and replace with fresh if damaged. Air spring bellow should not be painted.	Depot/ Work shop

Maintenance Instructions of FIBA

The following activities need to be done for the Maintenance of FIBA device. Check the condition of the mounting bracket, mounting bracket bolts, FIBA device cover of FIBA device.

1. Check for any physical damage to the FIBA device.
2. Check the condition of flexible hose, they should not be entangled or rubbing.

3. Check the pipe and pipe joints for any damage or leakage.
4. Check the condition of indicators, indicator brackets and mounting bolts.
5. Clean the indicators.

Perform the functional testing of the FIBA device

PREVENTIVE CHECKS ON WSP OF KNORR BREMSE

S.N	Item	Scope	Method of Checking	Result
1.	**Wiring**	a) Between speed sensor and junction box.	Two wires check continuity using multimeter.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor
		b) Between Junction Box and WSP Panel	i. Two wires disconnect at 1st junction box. ii. Fault code "11"will display on microprocessor. iii Cannot be reset. iv Connect back two wires. v It should be possible to reset "11" if connections have been made properly and are thus OK. vi Similarly, repeat for 2nd, 3rd, and 4th Junction Box. The corresponding fault codes are "21", "31", and "41".	1st Junction Box 2nd Junction Box 3rd Junction Box 4th Junction Box
		c) Between Dump Valve and WSP Panel	i. Three wires disconnect at 1st Dump Valve. ii. Fault code "13" will display on microprocessor. iii. Cannot be reset. iv. Connect back three wires. v. It should be possible to reset "13" if connections have been made properly and are thus OK. vi. Similarly, repeat for 2nd, 3rd, and 4th Dump valve. The corresponding fault codes are "23", "33" and "43".	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
2.	**K-05 Relay (01No)**	Timer Setting	Specified: 10+1 minutes	
3.	**Pressure Switch**	Cut in pressure Cut of pressure	0.5 Kg/cm^2 0.2 Kg/cm^2	

4.	**Speed Sensor (04Nos.)**	Check if Speed Sensors are providing the speed Signal to WSP	i. Fit "1" Sensor (duly wired to WSP) on the mounting flange of the 'Polradsimulator". ii. Run "Polradsimulator" for <2 seconds. iii. 1st Dump valve should operate (checked by air exhaust which takes place when dump valve operates). iv. This checks that 1st sensor is providing the speed signal to WSP. v. Similarly, check 2nd, 3rd, and 4th Dump Valves respectively operating.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor
5.	**Gap between Speed Sensor and Toothed Wheel**	To be checked by filler gauge.	Specified : 0.9 mm to 1.4 mm	Gap 1st Sensor Gap 2nd Sensor Gap 3rd Sensor Gap 4th Sensor
6.	**Dumps Valves (04Nos.)**	Check for operation of 04 Nos. Dump Valves.	i. Press "S2" switch on micro-processor. ii. Release "S2" switch when "8888" display on screen then dump valve will start operating as below: iii. 1st Dump Valve will operate. iv. 2nd Dump Valve will operate. v. 3rd Dump valve will operate. vi. 4th Dump Valve will operate. vii. "99" display will come on screen in the end. Air exhaust should take place from the Dump Valve when particular Dump Valve operates.	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
7	**Emergency Accelerator Valve (01 Nos.)**	Check for operation of Emergency Accelerator Valve by applying emergency brake thereby rapidly dropping BP up to 3 kg/cm^2 and then stop further dropping of BP	Momentary air exhaust should take place from Emergency brake is applied and then exhaust should stop automatically. Operating thus, the emergency Brake Valve is OK	Operates when BP drops at 2.5 kg/cm^2

PREVENTIVE CHECKS ON WSP of M/s FAIVELEY

S.No.	Item	Scope	Method of Checking	Result
1.	**Wiring**	a) Between speed sensor and junction box.	Two wires check continuity using multimeter.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor
		b) Between Junction Box and WSP Panel	i. Two wires disconnect at 1st junction box. ii. Fault code "11"will display on microprocessor. iii Cannot be reset. iv Connect back two wires. v It should be possible to reset "11" if connections have been made properly and are thus OK. vi Similarly, repeat for 2nd, 3rd, and 4th Junction Box. The corresponding fault codes are "21", "31", and "41".	1st Junction Box 2nd Junction Box 3rd Junction Box 4th Junction Box
		c) Between Dump Valve and WSP Panel	i. Three wires disconnect at 1st Dump Valve. ii.Fault code "14" will display on microprocessor. iii. Cannot be reset. iv. Connect back three wires. v. It should be possible to reset "14" if connections have been made properly and are thus OK. vi. Similarly, repeat for 2nd, 3rd, and 4th Dump valve. The corresponding fault codes are "24", "34"and "44".	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
2.	**K-05 Relay (01No)**	Timer Setting	Specified: 2 minutes	
3.	**Pressure Switch**	Cut in pressure Cut of pressure	2.0 Kg/cm^2 1.0 Kg/cm^2	
4.	**Speed Sensor (04Nos.)**	Check if Speed Sensors are providing the speed Signal to WSP	i. Fit "1" Sensor (duly wired to WSP) on the mounting flange of the 'Polradsimulator". ii. Run "Polradsimulator" for <2 seconds. iii. 1st Dump valve should operate (checked by air exhaust which takes place when dump valve operates). iv. This checks that 1st sensor is providing the speed signal to WSP. v. Similarly, check 2nd, 3rd, and 4th Sensor by fitting on "Polradsimulator" one by one Dump Valves respectively operating.	1st Sensor 2nd Sensor 3rd Sensor 4th Sensor

5.	**Gap between Speed Sensor and Toothed Wheel**	To be checked by filler gauge.	Specified : 0.9 mm to 1.4 mm	Gap 1st Sensor Gap 2nd Sensor Gap 3rd Sensor Gap 4th Sensor
6.	**Dumps Valves (04Nos.)**	Check for operation of 04 Nos. Dump Valves.	i. Press "TEST" switch on micro-processor. ii. Release "TEST" switch when "8888" display on screen then dump valve will start operating as below: iii. 1st Dump Valve will operate. iv. 2nd Dump Valve will operate. v. 3rd Dump valve will operate. vi. 4th Dump Valve will operate. vii. "99" display will come on screen in the end. Air exhaust should take place from the Dump Valve when particular Dump Valve operates.	1st Dump Valve 2nd Dump Valve 3rd Dump Valve 4th Dump Valve
7	**Emergency Accelerator Valve (01 Nos.)**	Check for operation of Emergency Accelerator Valve by applying emergency brake thereby rapidly dropping BP up to 3 bar and then stop further dropping of BP	Momentary air exhaust should take place from Emergency brake is applied and then exhaust should stop automatically. Operating thus, the emergency Brake Valve is OK	Operates when BP drops at 3.0 kg/cm^2

SINGLE CAR TESTING (LHB COACHES)

Pressure	BP	**Specified**	5 ± 0.1 kg/cm^2
	FP		6 ± 0.1 kg/cm^2

Pre-Inspection: Please ensure that all the pipe fittings, brake equipment are properly fitted and in place before starting of testing.

ITEM	TEST PARAMETERS	SPECIFIED VALUE
1.0	**Reservoir Charging**	
1.1	Charging time of AR (0 – 4.8 kg/cm^2)	175± 30 sec.(FTIL) 60 to 120 sec.(KB)
1.2	Charging time of CR (6.0 litre) (0 – 4.8 kg/cm^2)	165±20 sec.(FTIL) 160 to 210 sec.(KB)
1.3	BP Pressure	5.0±0.10 kg/cm^2
1.4	CR Pressure	5.0±0.10 kg/cm^2
1.5	FP Pressure	6.0±0.10 kg/cm^2
2.0	**Sealing test** (Allow the system to settle for 2 min. after charging BP & FP. Observe the rate of leakage).	
2.1	BP (Less than 0.1 kg/cm^2 in 5 minutes)	<0.1 kg/cm^2
2.2	FP (Less than 0.1 kg/cm^2 in 5 minutes	<0.1 kg/cm^2
3.0	**Full Brake Application**	
3.1	Reduce BP from 5.0 to 3.4 kg/cm^2	3 – 5 Sec.
3.2	Brake Accelerator should not respond	Should not respond
3.3	Maximum BC pressure	3.0 ±0.1 kg/cm^2
3.4	Leakage in BC Pressure within 5 minutes	<0.1 kg/cm^2
3.5	All brake cylinder are applied	Applied
3.6	Both side Brake indicators should show Red	Red
4.0	**Release full Brake Application**	
4.1	Charge BP (up to 5.0 kg/cm^2)	5.0±0.1 kg/cm^2
4.2	All brake cylinders are released	Released
4.3	Both side Brake indicators should show Green	Green
5.0	**Over Charge Protection** Check the overcharging of CR it should not be overcharged more than 0.1 kg/cm^2 in 10 second.	Less than 0.1 kg/cm^2 in 10 sec.
6.0	**Emergency Application**	
6.1	Reduce BP to 0 kg/cm^2	0 kg/cm^2
6.2	Brake accelerator should respond	blast of air
6.3	Charging time of brake cylinder (0 – 3.6 kg/cm^2)	3 – 5 Sec.
6.4	Max. brake cylinder pressure	3.0 ±0.1 kg/cm^2
6.5	All Brake Cylinders applied	Applied
6.6	Both side Brake indicator window should show red	Red
7.0	**Release emergency Brake application**	
7.1	BC release time (Maximum to 0.4 kg/cm^2)	15 -20 Sec.
7.2	All Brake Cylinder released	Released
7.3	Both side Brake indicator window should show Green	Green

8.0	**Graduated brake application and Release** Graduated brake application and Release (Minimum 7 steps)	Brake should apply & release corresponding to decrease & increase of BP Pressure.
9.0 9.1 9.2 9.3	**Test for Pressure switch for Anti skid device** Charge the Feed pipe/Brake pipe* pressure Anti skid device get power supply at 1.8±0.2 kg/cm^2 Anti skid device get power supply off at 1.3±0.2 kg/cm^2 * For FTIL - FP & For KBI - BP.	 Ok Ok Ok
ITEM	**TEST PARAMETERS**	**SPECIFIED VALUE**
10.0 10.1 10.2 10.3 10.4 10.5 10.6 10.7	**Isolation Test** Close the isolating cocks for Bogie –1 & 2 Reduce BP pressure to full brake application (Brake should not apply) Both side Brake indicators shows Green Open both isolating cock (Brake should apply corresponding to opening of isolating cock for bogies) Both side Brake indicators shows Red Again close the Isolating cock of bogie 1 & 2 one by one. Both side Brake indicators of bogie 1&2 shows Green one by one.	 Brake should not applied Green Brake apply Red Brake will Release Green
11.0 11.1	**Sensitivity Test** Reduce the BP pressure at the rate of 0.6kg/cm2 in 6 second.	 Brake should applied within 6 sec
12.0 12.	**Insensitivity Test** Exhaust BP pressure at the rate of 0.3 kg/cm^2 Per minute	 Brake should not applied.
13.0 13.1 13.2 13.3 13.4 13.5 13.6 13.7	**Passenger Emergency Pull Box testing** Pull the emergency pull box handle & check Brake accelerator does respond. BP Pressure exhaust from emergency brake valve Indicator Lamp on out side coach glowing Both side Brake indicators shows Red After resetting, exhaust from emergency brake valve is stopped Both side Brake indicators shows Green	 BP pressure should remain2.0±0.2 kg/cm^2 should respond Yes Yes Red Should stop Green
14.0 14.1 14.2 14.3 14.4 14.5 14.6 14.7	**Hand Brake test (Power car only)** Apply hand brake by means of wheel Both side Hand Brake indicators shows Red Brake Cylinders provided with hand brake lever are applied Movement of flex ball cable is proper Release hand brake by means of wheel Brake should release Both side Hand Brake indicators shows Green	 OK Red Applied Yes Ok Releases Green

15.0 15.1 15.2 15.3 15.4	**Emergency brake by guard van valve (Power car only)** Drop BP Pressure by means of guard valve (Brake Should apply) Brake accelerator should respond Both side Brake indicators shows Red & Hand Brake indicators shows Green Reset guard van valve (Brake should release)	 Brake Apply Blast of air OK Releases
16.0	**Manual release test** Apply full brake application and pull manual release wire of DV; it should be released in one brief pull of Manual release valve.	CR Drops to zero, Brake releases.
17.0 17.1 17.2 17.3 17.4 17.5	**WSP test** Check the Speed sensor air gap between sensor and Phonic wheel by means of filler gauge. (**At least four different locations**) Charge the BP/FP Pressure at full specified value. Check the WSP Micro Processor activated Check the WSP Micro Processor showing code 99. Check the Dump Valve venting by test mode	 KB - 0.7 to 1.5 mm FTIL -1.5 to 2.5 mm 1.8±0.2 kg/cm^2 Activated OK Venting one by one in proper sequence
18.0	Clearance between brake disc & brake pad	1.5 mm

AIR BRAKE TESTING PROCEDURE (RAKE)

1. On arrival of the rake on pit line, completely drain the AR tank (125 litres & 75 litres) of all the coaches by opening the drain cock, to remove the water in air.

2. Initially, couple the BP hose of the test rig with the BP hose of the rake & then charge the BP pressure to 5.0 kg/cm^2. Keep the FP angle cock of both end power cars in close position. Check the FP gauge fitted in the power car, if the gauge does not show any pressure, the NRV of all the coaches are ok. If, FP gauge shows any pressure, the NRV of any coach in the rake is defective. In this condition, check the rake for NRV defective by taking the coaches in parts. NRV found defective in particular coach should be replaced.

3. Open all the four cocks of rake, couple BP & FP hose pipe of test rig with the BP & FP hose pipe of the rake. Charge the BP & FP to 5.0 kg/cm^2& 6.0 kg/cm^2 respectively. After building of pressure in BP & FP, disconnect the test rig BP & FP hose pipe from the rake hose pipes & open both the angle cocks, due to which air pressure will be exhausted in atmosphere & brake will be applied. Wait for 20 to 25 minutes.

4. After 20 to 25 minutes, check the complete rake from one end. Note down the coach nos. found with release brake cylinder. Check whether, AR tank of the coach is charged or empty. If AR tanks found empty, write down Empty AR on the respective coach. If found charge, pull manual release of DV to check whether CR tank is charged / empty. If CR found empty, write down Empty CR on respective coach. With this, all the defects in the rake can be checked.

5. Again, connect BP & FP hose pipe of the rake & test rig & then charge BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2. Connect BP & FP gauges with dummy on free end of other power car.

6. Check the BP & FP pressure gauges in front power car, BP pressure should show 5.0 kg/cm^2 & FP pressure should show 6.0 kg/cm^2. If there is any difference in any pressure, check by fitting master gauge if still the pressure is not showing 5.0 kg/cm^2 in BP & 6.0 kg/cm^2 in FP, check for leakage & attend.

7. Close the BP & FP angle cock of test rig for 03 minutes. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

8. Attend the coaches in which AR empty & CR empty are found. Check the AR tank & pipe line from the back of the brake panel for leakage. Similarly, check CR tank & pipe line & dummy plug on the brake panel. If defect is still noticed after attending the leakage, than mark the coach sick for detailed investigation & single car testing in sick line.

9. Start the pressure & charge the BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2. Drop the BP pressure by 1.6 kg/cm^2, brake should apply in all coaches. Start the leakage checking with the help of soap solution from one end. During soap solution testing, check all the BP & FP hose pipe, all hose pipe connectors, Main pressure pipe line, Angle cocks, Brake cylinder pipe line, CDTS pipe line. Similarly, check & attend leakage in components on Brake panel like DV, FP & BP filter, NRV, all isolating cock, brake indicator, brake accelerator & brake cylinder with soap solution.

10. Isolate the isolating cock on Brake panel & check all brake callipers& brake pad of all cylinders. In isolated condition, all brake pads should be released simultaneously. Similarly, on opening of isolating cock all Brake cylinder should operate & brakes should apply.

11. Check the brake indicator when brakes are applied, indicator should display red colour. However, when the brakes are released from isolating cock the brake indicator should display green colour. If on brake release condition, brake indicator is not showing green or on brake applied condition brake indicator is not showing red, then the brake indicator is defective. Repair / replace the brake indicator.

12. The BP & FP pressure gauges in the others end power car should show pressure 3.4 kg/cm^2 & 5.8 - 6.0 kg/cm^2 respectively. If any difference in above pressure is noticed that means there is any cross connection in BP & FP connection. Attend the same & ensure BP pressure 3.4 kg/cm^2 & FP pressure 5.8 - 6.0 kg/cm^2.

13. Charge the BP & FP pressure to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Check the brake indicator of complete rake, all coaches should be in released condition. If any coach is not released, it means that the CR of that particular coach may be overcharged & there is an internal defect in DV. Mark the coach sick for detailed investigation.

14. Check PEASD of at least 03 coaches. During PEASD checking, brakes should apply in all coaches & the brake accelerator should operate. Coach numbers should be noted in maintenance dairy.

15. Now closed the pressure supply from the test rig. Operate the emergency guard van valve of front power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in front power car & approx. 40 to 50 sec in rear power car. Open the pressure supply & charge BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Now again closed the pressure supply from the test rig. Operate the emergency guard van valve of rear power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in rear power car & approx. 40 to 50 sec in front power car.

    Check for any significant difference in time for droppage of BP pressure to 0.0 kg/cm^2 between front & rear power cars. If any, there may be blockage in BP line of any coach. If found, attend the same. Continuity test of the rake is now completed.

16. In both the power cars, check the condition & mounting of hand brake cables fitted on both the brake cylinders. Rotate the hand wheel fitted in guard van clockwise to apply the brakes, after full rotation brake should apply in both the brake cylinders & hand brake indicator should show red. Rotate the hand wheel anti clockwise, now brakes of both the cylinders should get release & hand brake indicator should show green.

17. Charge the BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Close the BP & FP angle cock of test rig for 03 minute. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

18. Isolate the isolating cock of BP & FP of the test rig & angle cock of BP & FP of the cock. Uncouple both hose pipes & open both the angle cocks of coach. After draining of pressure from both the BP & FP hose, release the complete rake by pulling the manual release handle of the DV of each coach & ensure the brake indicator of all coaches should display green color. Ensure that all BP, FP & BC gauges fitted in power car are calibrated & showing correct reading.

WSP Testing

1. Initially with no pressure, the WSP processor in all the coaches should be OFF. If any processor is in ON condition, there is problem in any of pressure switch, wiring or K-05 relay. Attend the same.

2. Start the BP & FP pressure. The processor should automatically ON when BP pressure reaches 1.6 to 2.0 kg/cm^2 in M/s KNORR WSP system & when FP pressure reaches in M/s FTIL WSP system.

3. Check & attend for loose/proper fitment of WSP components like speed sensor, junction box, dump valve, dump valve connector & pressure switch.

4. Drop the BP pressure by 1.6 kg/cm^2, brake should apply in all the coaches. Now check the WSP processor for correct reading '99' on the electrical panel inside the coach. If the reading shows '99', it means that the WSP system is OK. Operate the test button on the processor to check the proper working of dump valves. The dump valve should operate in a sequence & pressure should be exhausted from brake cylinder. If the dump valve is not operated in proper sequence attend the same. Similarly, check & attend the WSP system of all the coach. All the WSP system should be in operating condition in the rake.

Chapter 6

Wheel Slide Protection Device

LHB coaches have been introduced on Indian Railways with state of art features. One of the important feature provided in these coaches are WHEEL SLIDE PROTECTION DEVICE (WSP). WSP control unit is a combination of various electronic cards. This unit is housed in electrical control panel units. This unit is connected by means of various cables through various equipments. During the course of brake application, there are possibilities of skidding/sliding/locking of individual axle. In these cases adhesion between the rails & wheels plays vital roll. Above situations are likely to cause damage to wheel sets with increased braking distance. The main purpose of using the WSPs is to utilize the available adhesion. The WSPs provided in the system avoids wheel sliding, also cuts the maintenance cost.

Requirement of WSP

- Poor Adhesion
- Because of high speed as 160 km/h and the emergency braking distance of 1200 meters, the adhesion could be insufficient to sustain the brake rate demanded during emergency breaking, especially when the surface of the rail is wet and slippery.

WSPis a

- A Brake Cylinder pressure regulation device.
- Adjusts the braking force to the wheel-rail friction (adhesion) so as to *make optimum use of available adhesion*
    - To optimize the braking distance and
    - To prevent wheel sliding.
- For 160 kmph& above WSP is recommended as requirement.

The WSP has the following major parts.

- Speed Sensor.
- Phonic wheel.
- Microprocessor.
- Dump valves.
- Pressure switch

Speed sensor:

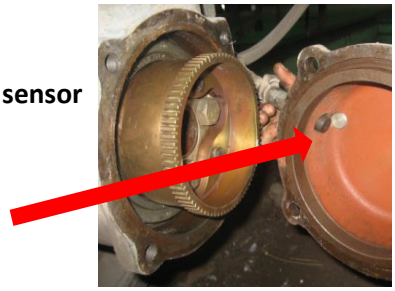
The speed sensors are fixed on one end of the axle boxcover with the help of two bolts. During fitment the gapbetween sensor probe & phonic wheel plays vital role. The gap can be adjusted with the help of shims & measured through the peephole in axle box cover. The other end of the speed sensor i.e. cable is connected to junction box in car.

Knorr BremseFaiveley

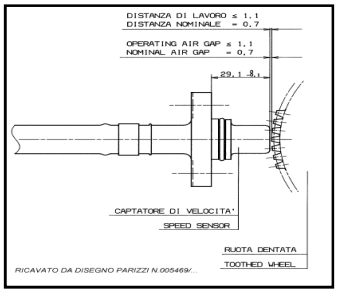
The main function of speed sensor is to pick up the signals with the rotation of phonic wheel mounted on axle end & convey to microprocessor.
The air gap between the rotating gear (Phonic wheel) & speed sensors probe should be

Knorr Bremse = 0.4 to 1.4 mm
Faiveley = 1.5 ± 0.5 mm

Speed sensor

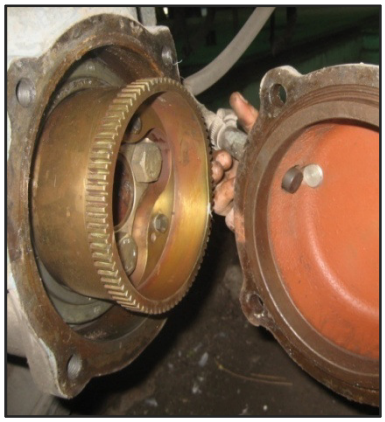


Note: pictures of speed sensors.



Phonic wheel:

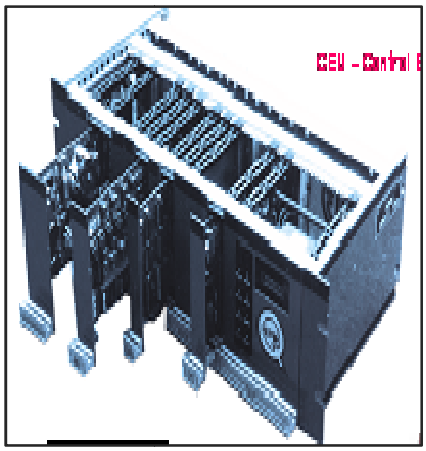
A phonic wheel is installed on one end of each axle. The phonic wheel is a toothed wheel (gear type). The purpose of this toothed wheel is to alter the internal inductance of the adjacent sensor. The change in internal inductance is evaluated as axle speed of various axles on a coach. During fitment, concentric movement of phonic wheel should be ensured. The eccentric movement of phonic wheel may cause signal errors, damage of speed sensor probe.



Phonicwheel

Microprocessor:

Microprocessor is the heart of the WSP system. This gathers the signals from phonic wheel & speed sensors, evaluates the vehicle speed. Moreover, during brake application, it monitors & bridges the sharp drop of speed of a particular axle/wheel, enabling the dump valve to control/adjust the brake cylinder pressure.
Each processor is provided with LED display & some test buttons. This LED displays various codes which can be decoded & the health of WSP system can be evaluated.



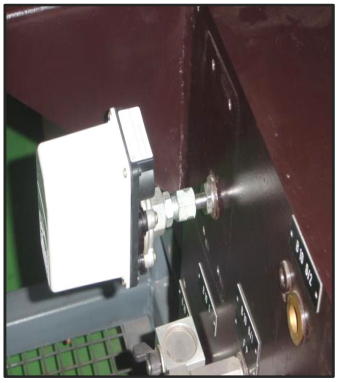
Dump valve/Anti skid valve:

A dump valve is provided for each axle of the vehicle. These dump valves are a type of solenoid valves, connected with the air pressure line of brake cylinder. Dump valve/antiskid valve should be fitted **close** to the brake cylinders. These dump valves allow to deplete the air available in brake cylinder line during brake application based on the signals from WSP microprocessor.

Pressure switch:

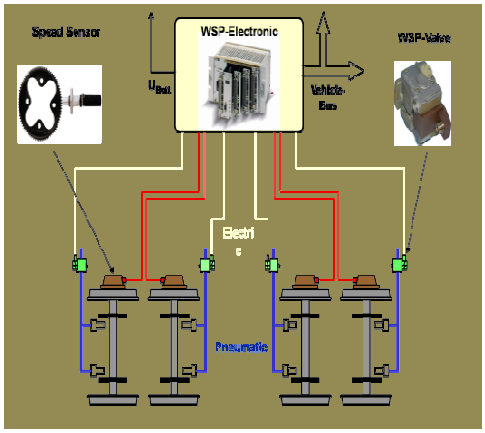
Pressure switch is provided on brake control panel. The purpose of pressure switch is to activate (i.e. to switch on) the WSP when the pressure reaches as given below.

System make	Working on pressure	Pressure range
Knorr Bremse	BP Pressure	0.2 Kg/cm^2 – 0.5 Kg/cm^2
Faiveley	FP Pressure	1.5 Kg/cm^2 – 1.7 Kg/cm^2



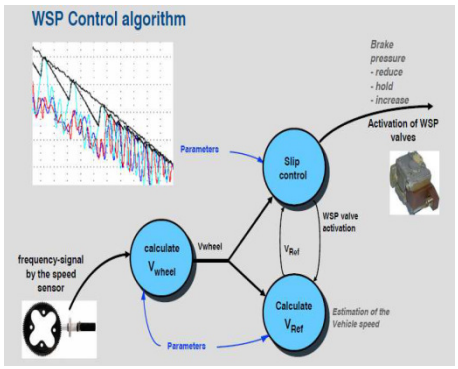
Working principle:

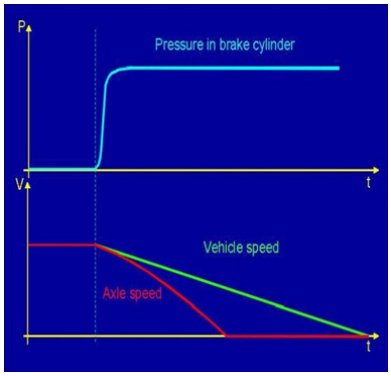
The processor unit evaluates the received signal from speed sensor mounted on each axle& generates signals enabling the dump valve/antiskid valves to control the brake cylinder pressure in case of any locking/skidding. The control on the brake cylinder pressure is instantaneous to the wheel to rail adhesion, keeping the wheels within their optimum range of skidding.



The limit of variation of speed and acceleration are defined as threshold values. The Micro Computer constantly compares the signals from the speed sensor mounted on each axle with the reference speed (The rotation of the fastest axle of the coach). If the speed/ acceleration of any axle is crossing the present threshold values, it gives signal to the respective dump valve to reduce the BC pressure accordingly, thus maintaining the speed/acceleration with in the threshold level.

Failure of WSP unit shall not have any influence on the braking function of the train except wheel slide control.





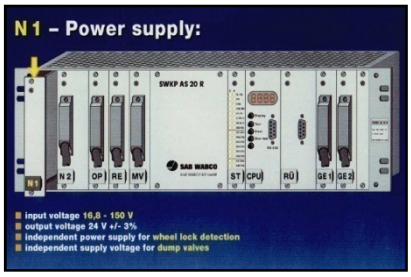
<u>Details of FAIVELEY WSP Systems:</u>

This system is separated into various components such as:

N1 (Power pack 1):

This unit supplies energy to the dump valves. This unit enables independent functioning of the control unit and dump valves.

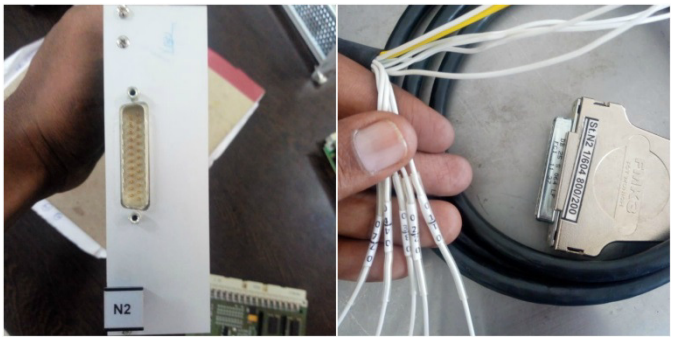
- Input voltage ranging from 16.8 to 150 Vdc
- Output voltage 24 V ± 3% dc



N2 (Power pack 2):

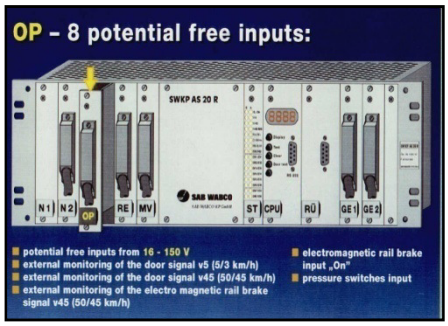
This unit supplies energy to all measuring& data processing units.

- Input voltage ranging from 16.8 to 150 Vdc
- Output voltage 24 V ± 3% dc
- Pressure switch input
- Low-voltage shut-off



OP (Opt coupler input): (Not in Use)

- 8 Potential-free inputs from 16 to 150 v DC.
- From these inputs, only 8th input is used for monitoring of pressure switch.

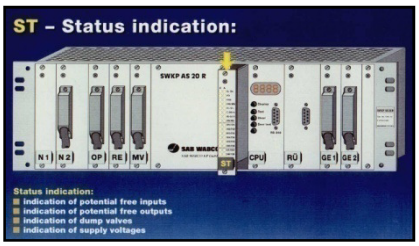


RE (Relay output):

- 6 potential-free outputs of 16 to 150 Vdc
- Out of 06 outputs, one output is used. Remaining 5 are not used by system.
- Output 5: Toilet discharge: close at V>30km/h; open at V<28km/h

ST (Status display):

- Used for monitoring of all Inputs & outputs (OP & RE).
- Used for monitoring dump valves and four supply voltages (BV= charging of brake cylinder; EV= exhausting of brake cylinder).



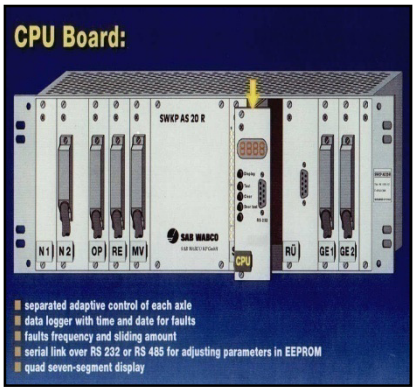
MV (solenoid amplifier):

- Four solenoid amplifiers per assembly.
- Constant voltage supply of 24 volts for solenoids irrespective of battery voltage.

This module is used for controlling the dump valves via bipolar output amplifier.

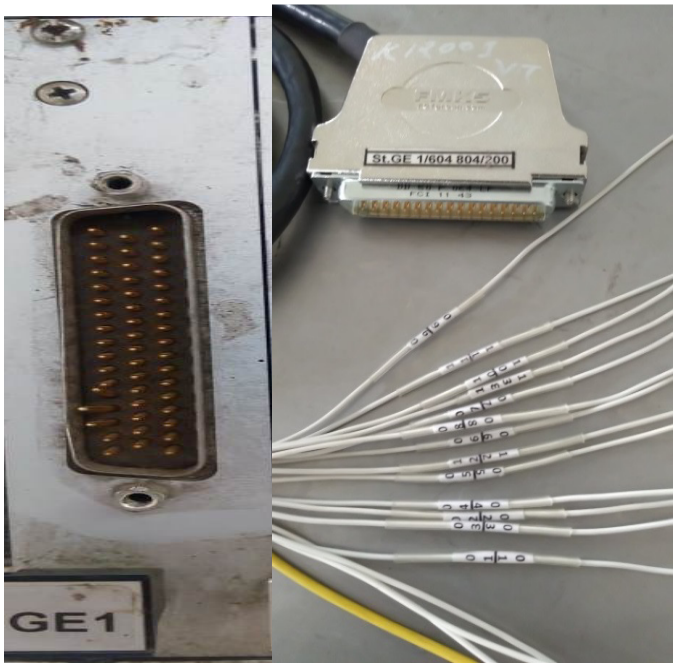
CPU (Central processing unit):

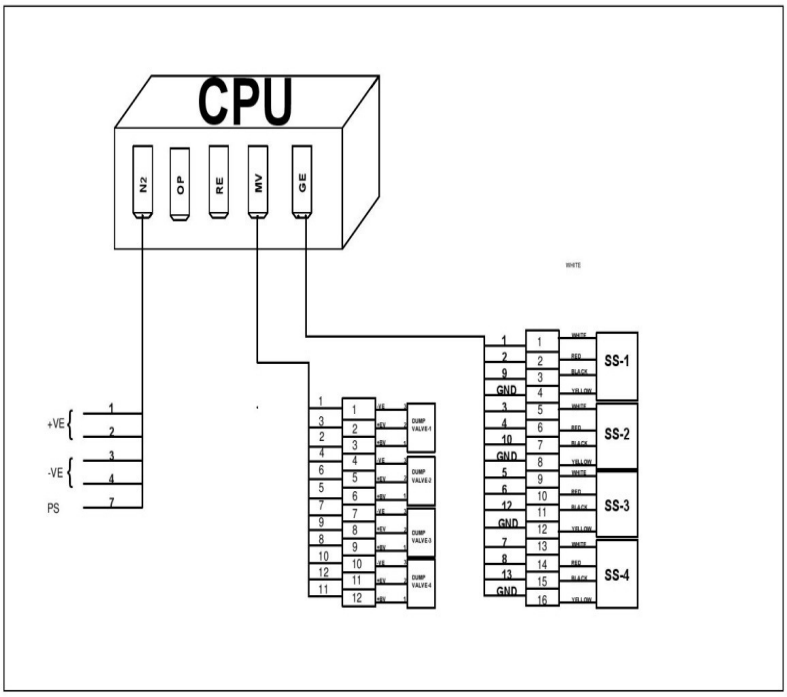
- Selective regulation of brake cylinder pressure of the wheel set.
- Date received & is stored permanently for diagnostic purpose.
- Error recording with date, time & frequency.
- 9-channel SUB-D plug for connecting PC (RS 232)
- 4-digit 7-segment display for service & maintenance.



GE (Speed recording):

Energy supplier for the speed sensors Dynamic test for each speed sensor.
Analogue output of reference speed.
The GE module acquires the speed sensor data.
The sensors are supplied & tested continuously by this module.





SIMPLIFIED CIRCUIT DIAGRAM OF MAIN COMPONENTS OF FAIVELEY

Testing procedure (Faiveley):

Step 1: Test

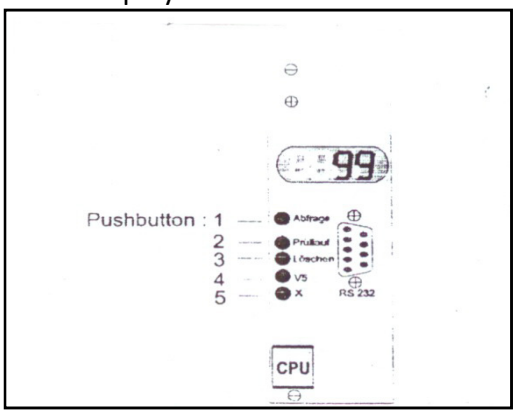
To test the system, push button 2 (Test) to be pressed for atleast 3sec. The indication “89” appears and following functions take place:

All the brake cylinders of axles 1 - 4 are vented in succession. The correct alignment of dump valve and speed sensor of all the axles starting from axle 1 is checked. Any failure in this will result in inaccurate axle speeds being measured which causes false pressure values are set in the dump valves.

Note: The axles are measured as 1 & so on from opposite side, where the microprocessor is fitted.

Step 2: Diagnostic of Faults

As push button 1 is pushed & the code displayed is different to 99 (ie. 95 or 72 or 73) or the system is switched off. The CPU will switched on & by pressing the push button 1 for minimum 3sec, the faults can be displayed.



The following functions also take place:

- Indication “88” for 3 sec (7-segment LED test)
- Indication of all faults in a sequence of 3 sec.

Step 3: Clearing of failure memory

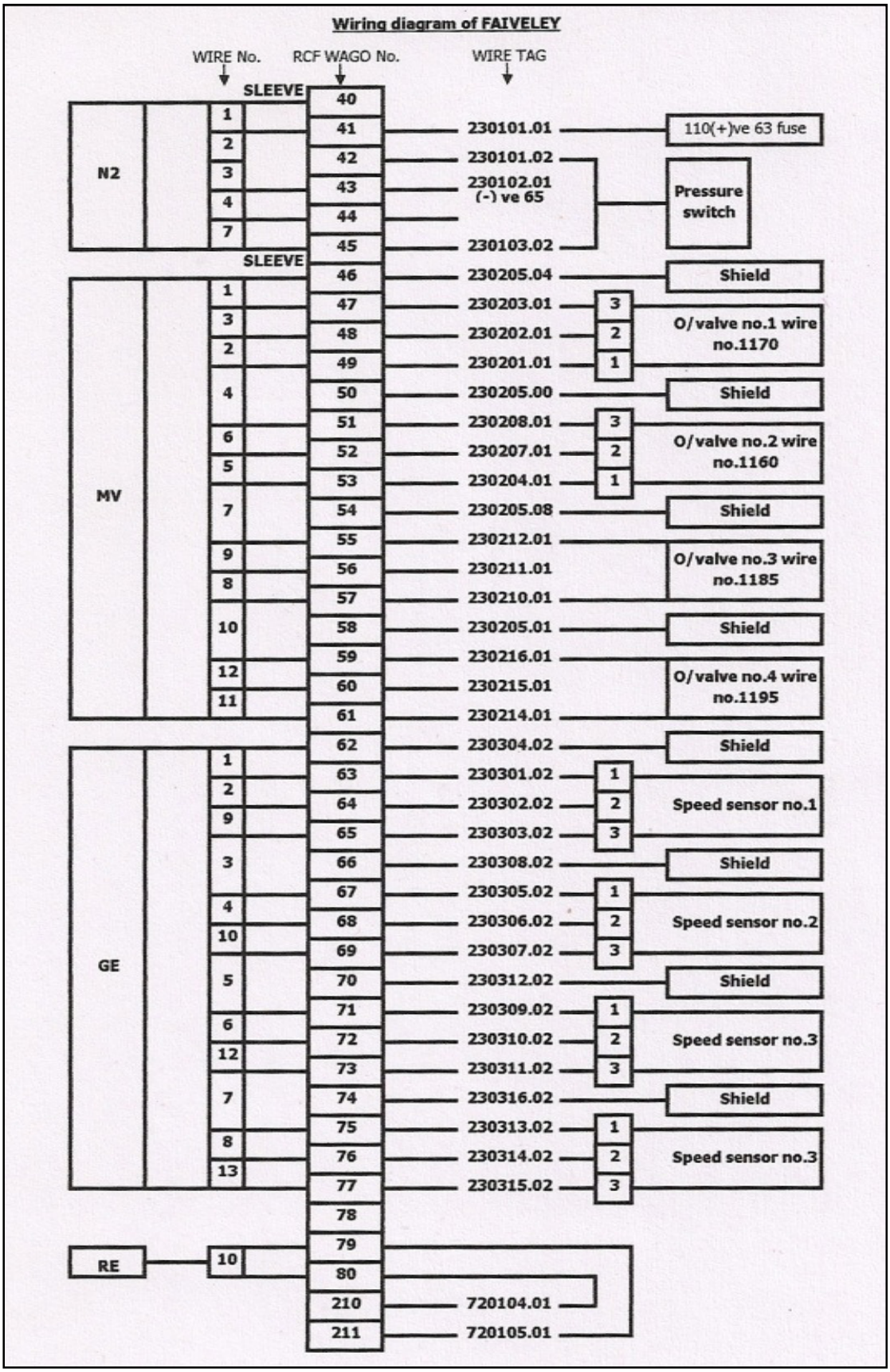
By pressing the push button 3 for minimum 3 sec, the following function takes place

- Indication of “cLr”
- Clearing of all historical faults.

Step 4: Doortest *(Not in use)*

Step 5: X/ Kilometer counter

By pressing the push button for minimum 3 sec, the distance will be shown on the display. The distance is value with 8 positions and is divided into two parts. At first, most significant part is shown on display followed by the least significant part.


Wiring diagram of FAIVELEY
WIRE No.
RCF WAGO No.
WIRE TAG
SLEEVE
N2
1
2
3
4
7
40
41
42
43
44
45
230101.01
230101.02
230102.01
(-) ve 65
230103.02
110(+)ve 63 fuse
Pressure switch
SLEEVE
MV
1
3
2
4
6
5
7
9
8
10
12
11
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
230205.04
230203.01
230202.01
230201.01
230205.00
230208.01
230207.01
230204.01
230205.08
230212.01
230211.01
230210.01
230205.01
230216.01
230215.01
230214.01
Shield
O/valve no.1 wire no.1170
Shield
O/valve no.2 wire no.1160
Shield
O/valve no.3 wire no.1185
Shield
O/valve no.4 wire no.1195
GE
1
2
9
3
4
10
5
6
12
7
8
13
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
230304.02
230301.02
230302.02
230303.02
230308.02
230305.02
230306.02
230307.02
230312.02
230309.02
230310.02
230311.02
230316.02
230313.02
230314.02
230315.02
Shield
Speed sensor no.1
Shield
Speed sensor no.2
Shield
Speed sensor no.3
Shield
Speed sensor no.3
RE
10
78
79
80
210
211
720104.01
720105.01

Details of KNORR BREMSE WSP Systems:

This electronic unit is mounted in a rake case & housed in the electrical controlled panel. This system consists of following parts:

Power board:

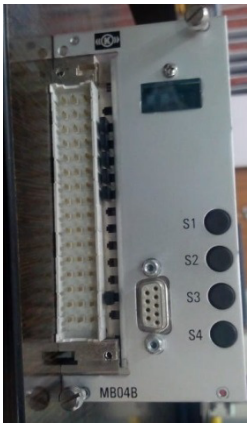
The power boards are fitted in a closed box. Its front panel has two yellow LED's indicating the operating state. This board supplies the voltage for powering the boards, actuators and speed sensors. For powering the anti-skid valve a 24 V source is used from MGS2 control unit. Input Supply voltage – 24V ± 30% DC to 110 ± 30% DC.

Boards MB04

Wheel Slide Control (i.e. acceleration & slip control) is implemented entirely on board MB04. MB04 contains all the electronic peripherals for individual wheel slide control at up to four wheels. MB04 board has a man-machine interface (MMI) integrated in its font panel. MB04 supply 24 V Dc to all the Dump valve

Features:

- Four configurable input circuits for the speed sensors with short circuit proof power supply.
- Micro controller monitoring & fail safe mode.
- Eight semiconductor output stages for four anti skid valves with two magnets each. Two mechanical relays to cut off the magnet valves for safety in response to a malfunction.



Man-Machine Interface (MMI) comprises of :

- a 9 pin sub D female connector for the RS 232 interface (to connect a PC terminal)
- a 4 character alphanumeric display.

Board EB01

<table>
<tr>
<td>It is an extension board in MGS2 control unit. It provided digital inputs & outputs which are utilized for supplementary functions such as door control, toilet criteria.
Features:
• It serves as watchdog.
• Eight digital inputs,galvanically isolated from MGS2 potential, outputs and one another.</td>
<td> 

• Eight relay outputs, galvanic ally isolated from MGS2 potential, inputs and one another. Twogalvanic ally isolated frequency outputs.</td>
</tr>
</table>

Testing procedure (Knorr Bremse):

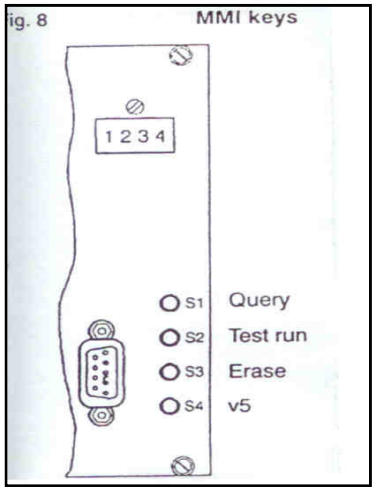
By pressing the keys on MMI, three different test runs can be performed. The test runs are terminated automatically when a speed signal higher than 03 kmph is identified.

Step 1 - "Valve control" test run

By pressing the key "S2" on MMI for about one sec, the valve control test run starts.

The display will show "8888" for the first three seconds & then switches to "89". Faults found by the test are displayed at the end of the run. Volatile faults that have occurred at some time on the move and disappeared again in the meantime (e.g. loose contacts), are displayed as number "95". The display switches to "99" if the fault memory is still empty at the of the test run.

All the brake cylinders of axles 1 - 4 are vented in succession. The alignment of anti skid valve and speed sensor of all the axles starting from axle 1 is checked. Any failure will result in inaccurate axle speeds being measured which causes false pressure values are set in the anti skid valves.



Step 2 –"Door control" test run (Not in use)

Step3 Fault memory:

Retrieving faults from memory

The display return code "99" if the fault memory is empty & no keys are pressed. The display shows code number "95", if any volatile faults are in memory.

Press key "S1" to start the query. To begin with, the display reads "8888".

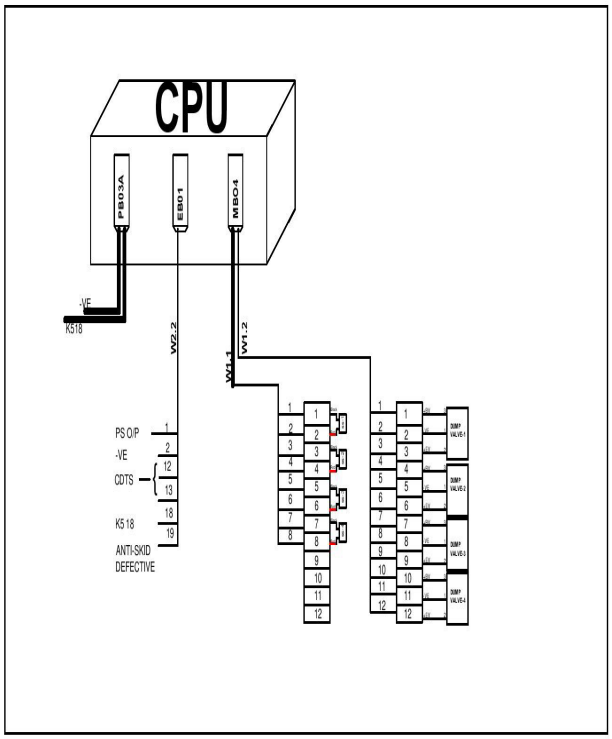
All current faults are displayed for three seconds each. The display subsequently reads "95" & then shows the volatile faults.

Erasing faults from memory

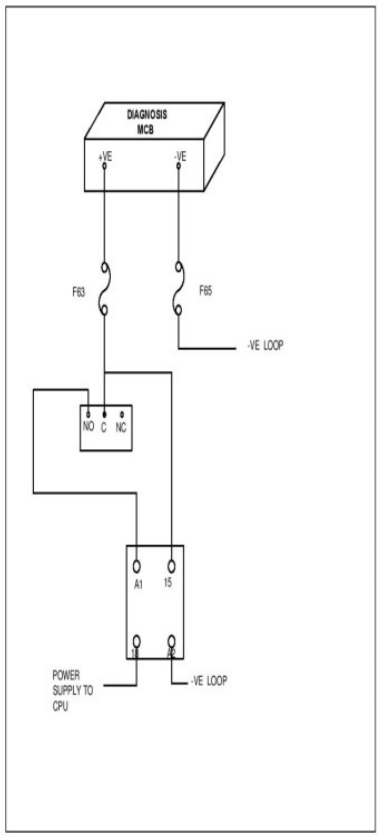
The fault memory is erased when the erase key "S3" is pressed for about one second. However, persistent faults will be entered instantly again in the fault memory.

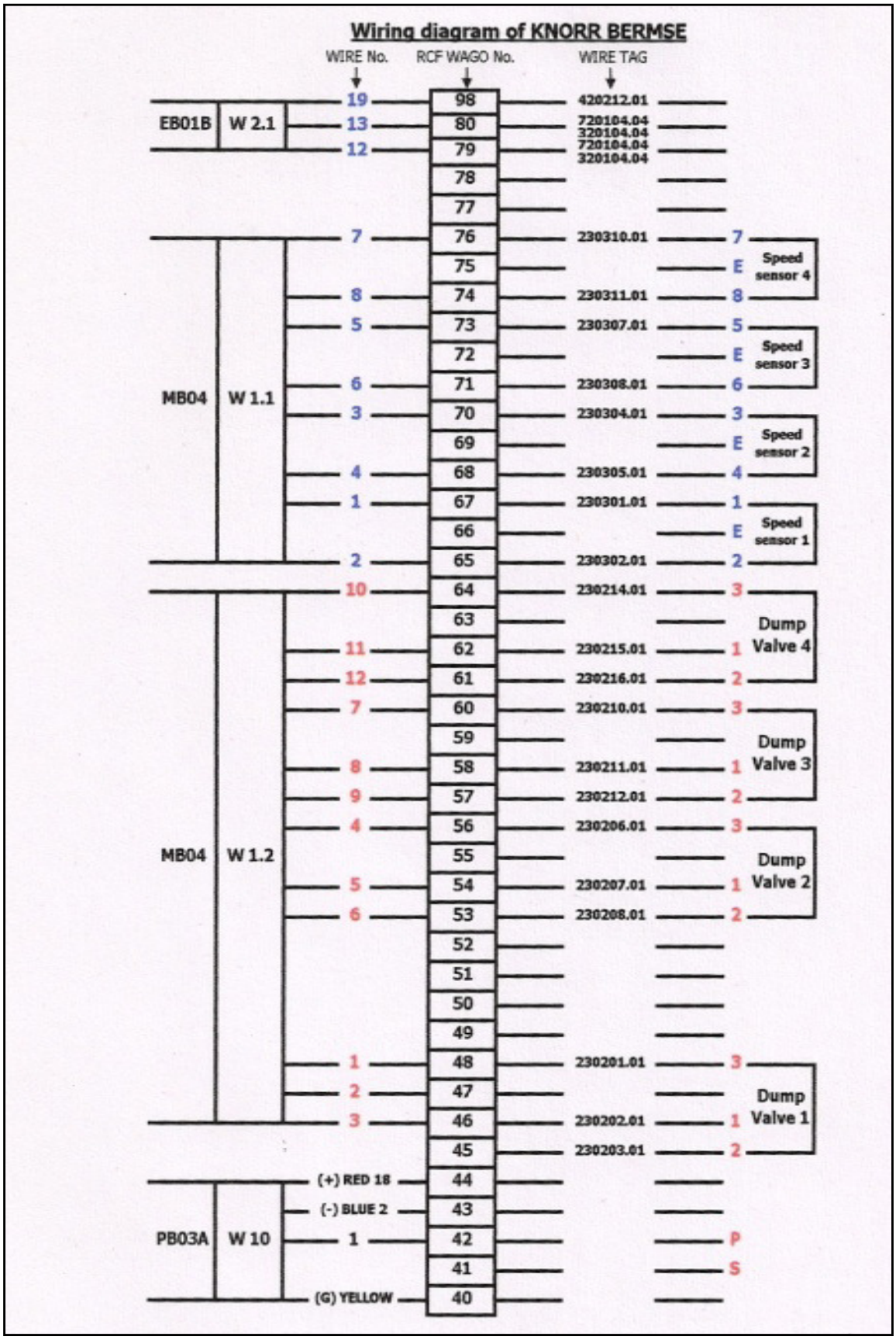
Service Terminal:

An interface PC can be connected with port on MMI RS 232 for monitoring diagnostic output of the system.



SIMPLIFIED CIRCUIT DIAGRAM OF MAIN COMPONENTS OF KNORR BREMSE




Wiring diagram of KNORR BERMSE
WIRE No.
RCF WAGO No.
WIRE TAG
EB01B
W 2.1
MB04
W 1.1
MB04
W 1.2
PB03A
W 10
(+) RED 18
(-) BLUE 2
(G) YELLOW
Speed sensor 4
Speed sensor 3
Speed sensor 2
Speed sensor 1
Dump Valve 4
Dump Valve 3
Dump Valve 2
Dump Valve 1

Technical parameters of WSP System

S.No.	Parameter	Specified
1.	Air gap betweenSpeed Sensor & Phonic wheel- Faiveley	1.5 +/- 0.5mm
2.	Air gap betweenSpeed Sensor & Phonic wheel gap - Knorr	0.9 +/- 0.5mm
3.	Pressure switch setting to Switch on WSP- Faiveley	1.5 - 1.7 Kg/Cm²(FP)
4.	Pressure switch setting to Switch on WSP- Knorr	0.2-0.5 Kg/Cm²(BP)
5.	Operating Voltage of WSP control panel	110V DC
6.	Dump Valves operating voltage	24 V DC

1.5 Defects analysis & trouble shooting (Faiveley):

LED display of WSP displays information about the working/failures of system. The displays are in numerical form. Each figure code describes different type of failure & their probable cause. Details of code in display & cause are as under:

Defect codes with Troubleshooting:

Code in Display	Failure code	Failure cause	Corrective action
72/73	10	Hardware watchdog of solenoid valve of axle 1 is triggered.	Acknowledge the failure, continue the operation.
72/73	11	Short circuit or interruption of speed sensor of axle 1	Check the wires for short circuit or interruption
72/73	13	Short circuit of solenoid valve of axle1	Wires or solenoid of the dump valve should be checked for short circuits, acknowledge the failure.
72/73	14	Interruption of solenoid valve of axle 1	Wires or solenoid of the dump valve should be checked for interruption, acknowledge the failure.
72/73	20	Hardware watchdog of solenoid valve of axle 2 is triggered.	Acknowledge the failure, continue the operation.
72/73	21	Short circuit or interruption of speed sensor of axle 2	Check the wires for short circuit or interruption
72/73	23	Short circuit of solenoid valve of axle2	Wires or solenoid of the dump valve should be checked for short circuits, acknowledge the failure.
72/73	24	Interruption of solenoid valve of axle 2	Wires or solenoid of the dump valve should be checked for interruption, acknowledge the failure.
72/73	30	Hardware watchdog of solenoid valve of axle 3 is triggered.	Acknowledge the failure, continue the operation.

72/73	31	Short circuit or interruption of speed sensor of axle 3	Check the wires for short circuit or interruption
72/73	33	Short circuit of solenoid valve of axle 3	Wires or solenoid of the dump valve should be checked for short circuits, acknowledge the failure.
72/73	34	Interruption of solenoid valve of axle 3	Wires or solenoid of the dump valve should be checked for interruption, acknowledge the failure.
72/73	40	Hardware watchdog of solenoid valve of axle 4 is triggered.	Acknowledge the failure, continue the operation.
72/73	41	Short circuit or interruption of speed sensor of axle 4	Check the wires for short circuit or interruption
72/73	43	Short circuit of solenoid valve of axle 4	Wires or solenoid of the dump valve should be checked for short circuits, acknowledge the failure.
72/73	44	Interruption of solenoid valve of axle 4	Wires or solenoid of the dump valve should be checked for interruption, acknowledge the failure.
95	10	Hardware watchdog of solenoid valve at axle 4 is triggered.	Acknowledge the failure, continue the operation.
95	11	Short circuit or interruption of connection between speed sensor at axle 1 and WSP	1. Check the wires for short circuit or interruption. 2. Replace speed sensor
95	13	Short circuit at solenoid valve of axle 1.	1. Check the wires and valve for short circuit, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	14	Interruption of solenoid valve of axle 1	1. Check the wires and valve for interruptions, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	20	Hardware watchdog of solenoid valve of axle 2 is triggered.	Acknowledge the failure, continue the operation.
95	21	Short circuit or interruption of connection between speed sensor of axle 2 and WSP	1. Check the wires for short circuit or interruption. 2. Replace speed sensor, acknowledge the failure.
95	23	Short circuit at solenoid valve of axle 2.	1. Check the wires and valve for short circuit, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.

95	24	Interruption of solenoid valve of axle 2.	1. Check the wires and valve for interruptions, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	30	Hardware watchdog of solenoid valve of axle 3 is triggered.	Acknowledge the failure, continue the operation.
95	31	Short circuit or interruption of connection between speed sensor of axle 3 and WSP	1. Check the wires for short circuit or interruption. 2. Replace speed sensor, acknowledge the failure.
95	33	Short circuit at solenoid valve of axle 3.	1. Check the wires and valve for short circuit, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	34	Interruption of solenoid valve of axle 3.	1. Check the wires and valve for interruptions, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	40	Hardware watchdog of solenoid valve of axle 4 is triggered.	Acknowledge the failure, continue the operation.
95	41	Short circuit or interruption of connection between speed sensor of axle 4 and WSP	1. Check the wires for short circuit or interruption. 2. Replace speed sensor, acknowledge the failure.
95	43	Short circuit at solenoid valve of axle 4.	1. Check the wires and valve for short circuit, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.
95	44	Interruption of solenoid valve of axle 4	1. Check the wires and valve for interruptions, acknowledge the failure. 2. Replace solenoid valve, acknowledge the failure.

Table of Failure Codes:

Axle	Code	Description
1	10	Safety shut - down MV (Dump Valve)
	11	Short circuit / interruption GE (Speed Sensor)
	13	Short circuit MV (Dump Valve)
	14	Interruption MV (Dump Valve)
2	20	Safety shut - down MV (Dump Valve)
	21	Short circuit / interruption GE (Speed Sensor)
	23	Short circuit MV (Dump Valve)
	24	Interruption MV (Dump Valve)

3	30	Safety shut - down MV (Dump Valve)
	31	Short circuit / interruption GE (Speed Sensor)
	33	Short circuit MV (Dump Valve)
	34	Interruption MV (Dump Valve)
4	40	Safety shut - down MV (Dump Valve)
	41	Short circuit / interruption GE (Speed Sensor)
	43	Short circuit MV (Dump Valve)
	44	Interruption MV (Dump Valve)
	70/71	Failure in electronic card RE (relay output)
	72	WSP disturbance, one axle
	73	WSP disturbance, several axles
	HF	Global hardware failure
	Pr	Processor
	EP	EPROM
	EE	EEPROM
	Hd	Hardware watchdog
	8888	Segment test
	89	Test run
	95	Intermittent fault
	99	Good indication

Defects analysis & trouble shooting (Knorr Bremse):

LED display of WSP displays information about the working/failures of system. The displays are in numerical form. Each figure code describes different type of failure & their cause. Details of code in display & cause are as under:

Defect code with Trouble shootings:

Display	Fault	Problem Source	Connected with
02	Digital I/Os	Board EB01A	
03	Central processing unit	Board MB04A	
10	Time out	Board MB04A	Wheelset 1
11	Short circuit / open circuit	Speed sensor 1/feeder	
12	Signal error	Speed sensor 1/feeder	
13	Short circuit	Dump Valve 1/feeder	
14	Open circuit	Dump Valve 1/feeder	
15	Safety monitor defective(test run)	Board MB04A	
20	Time out	Board MB04A	Wheelset 2
21	Short circuit / open circuit	Speed sensor 2/feeder	
22	Signal error	Speed sensor 2/feeder	
23	Short circuit	Valve 2/feeder	
24	Open circuit	Valve 2/feeder	
25	Safety monitor defective(test run)	Board MB04A	

30 31 32 33 34 35	Time out Short circuit / open circuit Signal error Short circuit Open circuit Safety monitor defective(test run)	Board MB04A Speed sensor 3/feeder Speed sensor 3/feeder Valve 3/feeder Valve 3/feeder Board MB04A	Wheelset 3
40 41 42 43 44 45	Time out Short circuit / open circuit Signal error Short circuit Open circuit Safety monitor defective(test run)	Board MB04A Speed sensor 4/feeder Speed sensor 4/feeder Valve 4/feeder Valve 4/feeder Board MB04A	Wheelset 4
70 71 72 73 74 c8	Speed signal fault, door control Speed signal fault, electromag track brake Fault at one wheelset Fault at several wheelsets Safety monitor fault Activation fault, cumulative fault signaling	Board EB01A Board MB04A Board EB01A	
S2 S3	Connector defect board EB01A Connector defect board MB04A	Board EB01A Board MB04A	
8888 89 95 99	Display test Test running Volatile faults System good		

CPU not switch on	a) check diagnosis MCB (F-32) 110v DC (replace if defective) b) check 110v DC power supply at F-32 MCB input and output c) check fuses (F-63) 110v DC +ve& F65 110 v DC –ve(replace if defective) d) check pressure switch (replace if defective) e) check 110v DC power supply at pressure switch and continuity of the wires (rectify if any problem) f) check k-5 relay replace if any defective. g) check any loose or open wires as per circuit. h) replace N-2 (power pack -2) card for FAIVELY i) check N2 Power connector for continuity, replace if any defective j) Replace PB03A (power board) k) check PB03A power connector for continuity , replace if any defective
Speed sensor Short / Open circuit	Check Speed sensor , replace if defective as per defect code Check Speed sensor wire connections at under frame junction box as per code Check Speed sensor wire connections at panel board near CPU Check MB04 W1.1 connector for continuity, Replace if any defective

	(knorr) Check MB04 card, replace upon defect (Knorr) Check GE connector for continuity, Replace if any defective (Faiveley) Check GE card, replace upon defect (Faiveley)
Dump valve	Check dump valve working ,replace if any defective as per defect code Check dump valve connector , replace if any defective as per defect code Check dump valve connections at under frame junction box for any loose / open wires Check dump valve wire connections at panel board near CPU Check MB04 W1.2 connector for continuity, Replace if any defective (knorr) Check MB04 card, replace upon defect (Knorr) Check MV connector for continuity, Replace if any defective (Faiveley) Check MV card, replace upon defect (Faiveley)

Chapter 7

Wheel Shelling

Wheel shelling, separation of metal from wheel, is a rolling contact fatigue phenomenon that leads to damage on the wheel tread and eventually small pieces of the wheel tread break off. Shelling can be identified by pieces of metal breaking out of the tread surface in several places more or less continuously around the rim.
Shelling takes place when small pieces of metal break out between the fine thermal checks. These are generally associated with small skid marks or “chain sliding”

Thermal cracking defect:

Thermal cracking is a process that requires elevated temperatures which is generated during severe braking.

Thermal cracks appear on a wheel tread due to intense heating of the wheel arising out of severe brake binding. Such cracks occur on the tread and generally progress across the tread in a transverse & radial direction. Whenever such a crack becomes visible on the outer face of the rim or tread crack has reached the outer edge (non-gauge face) of the rim, the wheel should be withdrawn from service. If a crack becomes visible on the outer flange face, the wheel should be from service.

Sliding defect:

It occurs when wheel slide (skids) while on run as a result of the retarding force between wheel and brake shoe is greater than the adhesive force between wheel and rail.

Wheel Spalling defect:

It occurs in service after the wheel slides on the rail and patches of martensite are formed on the tread. In spalling, the crack network is either perpendicular or parallel to the surface.

Shattered Rim defect:

This type of defect originate at the sub-surface of tread resulting in fatigue initiation which further progresses circumferentially and when the fatigue crack gets connected with tread surface, a chunk of metal is dislodged from tread.

Preventive/control measures for Wheel Shelling

1. Close visual check of wheel treads during trip maintenance
2. Wheel tapping to be done on pits during trip schedule maintenance.
3. Visual check for damage/crack, corrosion or any foreign body of brake callipers.
4. Ensure free movement of brake callipers by shaking them manually
5. Lubrication of all moving parts of Brake callipers.
6. Close visual check of brake discs for damage/cracks/wear etc., and verify for any axial movement of brake disc
7. Check condition of brake pads for any damage/crack/wear.
8. If any brake pad warrants replacement, then replace all the brake pads as a set.
9. Check for any breaks/damage on Earthing cables and Speed sensor cables and rectify if found damaged/broken.
10. While performing functional test:
    i. Follow laid down procedure for functionality test
    ii. Check for air leakages at joints by means of soap solution
    iii. Check functioning of Wheel slide Protection & dump valves as per OEM Maintenance Manual
    iv. Functioning of Emergency Valve & Alarm pull box
    v. Visual check of Hand-Brake equipment for damages/cracks/corrosion. And replacement if found defective
    vi. Check for proper functionality of Hand Brake equipment

Visual check of wheels

Lubrication of Brake Callipers

Check for air leakages at joints by means of soap solution

Chapter 8

Ferrule Fittings

Introduction

Indian Railways has started using the Stainless Steel Tubes and Double Ferrule fittings (Compression Tube Fittings) in the Brake system in order to have leak-proof joints. This type of joint will cut down POH down time and cost in long run. This kind of fittings are almost maintenance free and does not need any replacement during POH, unlike in case of MS joints which needs to be replaced because of high corrosion.
Earlier the Railways have been using IS: 1239 seamless pipes with Mild Steel fittings having threads and welded joints and were installed by conventional methods. These were prone to periodical maintenance and replacement of pipes and fittings due to high rate of corrosion. The use of Stainless Steel Double Ferrule fittings avoids the same.

Working principle of Ferrule Fittings

The two ferrule system works on combination of geometry and metallurgy.
Total action in the fitting is by an axial movement (thus avoiding torque transmission) along the tube instead of rotary motion to create the joint. No threading of pipe is required.

Demerits of screwed joints

- Needs thick walled pipes.
- Often causes high stressing of individual threads.
- Less withstanding capacity towards angular, torsional and linear vibrations.
- Replacements of fittings between overhauls are very high.

Demerits of welded joints

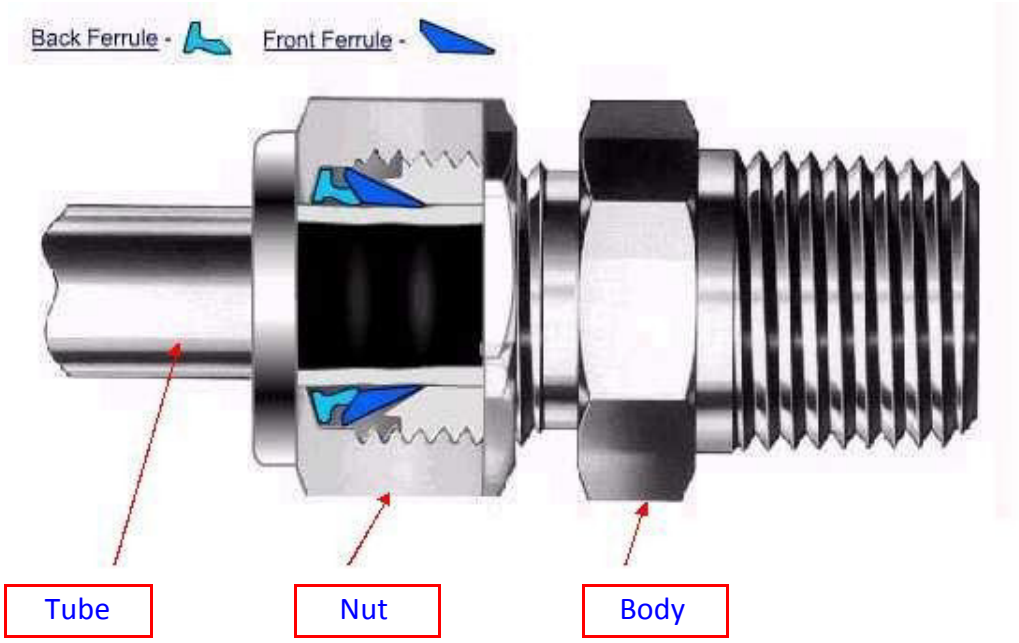
- Resistance to corrosion becomes less due to heat generation during welding.
- Testing of welded joints becomes laborious process.
- Less withstanding capacity towards angular, torsional and linear vibrations.

Merits of Ferrule Fittings

- It is self aligning.
- Works on thin wall tubes. (no threads)
- Resists vibration.
- Easy to install.
- Re-usable (up to 25 times re-assembling - equal to codal life of coach i.e. 25 years).
- Does not require any special skill for assemble **ferrule fittings:** -A double ferrule consist of four piece as following:-

  - Body
  - Nut
  - Back Ferrule
  - Front Ferrule

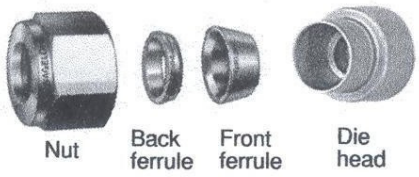
The illustration below explains the parts



MAINTENANCE INSTRUCTIONS

Assembly of double ferrule fittings:-
The Fittings are assembled as follows:

Step 1:
Pre-swaging



The details without tubes are shown above, which are to be assembled in this sequence in to the swaging machine.

Nuts are supplied with silver coating (anti-galling agent) on threads to avoid damage to threads when disconnected and retightened many times.

Tube Preparation

Cut the tubes at right angles (90°) and de-burr cut-edges

Check the tubes for ovality, smooth surface, remove the end caps and clean the inner passage by pressurized air to remove any unwanted particles

(Dirt, Grease, Burrs, etc.)

Installation instruction:-

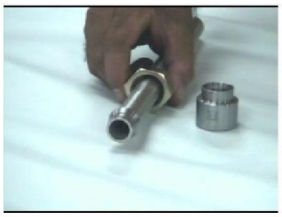
Insert the tubing in to the Tube fittings. Make sure the tube rests firmly on the shoulder of the fittings and perpendicular to the axis of the tube.

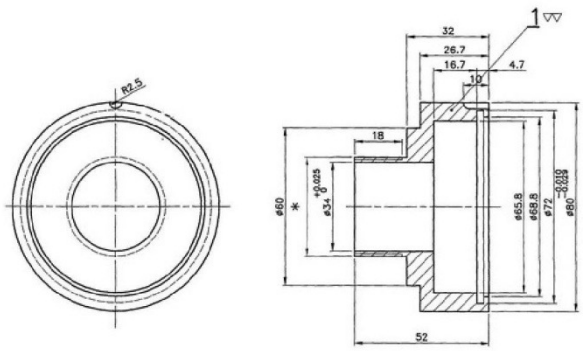
The ferrules have to be pre-swaged using swaging machine with proper dies

Swaging Machine

Swaging machine shall only be used for swaging of ferrules onto the SS tube.

In case of manual swaging, Swaging Die Block shall be used.





Step 2 :

After pre-swaging of ferrules (both front & back) on to the tube along with nut, the nut has to be manually tightened with body to half a turn with appropriate tool to ensure leak proof joint.

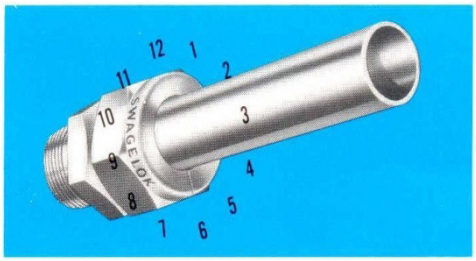
In case of Manual Swaging

Step 1 :

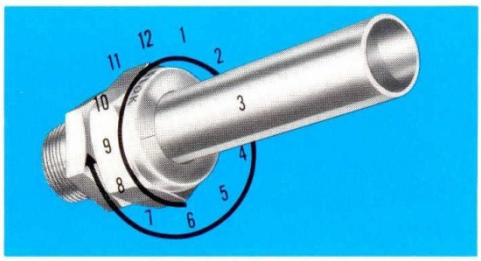
Insert the tubing in to the Tube fittings. Make sure the tubing rests firmly on the shoulder of the fitting and that the Nut is finger-tight.

Step 2:

Before tightening the Nut, scribe the nut at 6 o' clock position.



Step 3:



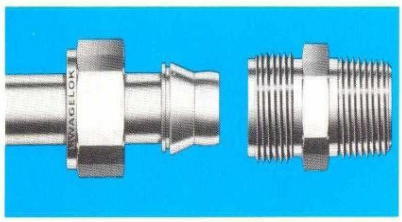
Hold the Fittings body tightly with the backup wrench and tighten the nut 1-1/4 turns. Watch the scribe mark, make one complete revolution and continue to 9 o' clock position.

By scribing the nut at the 6 o' clock position it appears to you, there will be no doubt as to the starting position. When the Nut is tightened 1-1/4 turns to the 9 o' clock position, you can easily see that the fitting has been properly installed.

Retightening instruction:-

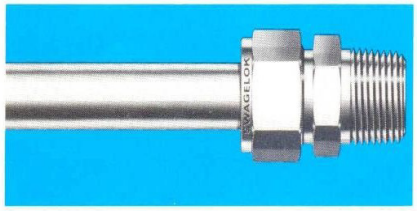
The connections can be disconnected and retightened many times. The same reliable leak-proof joint can be obtained every time the connection is made.

1. Fitting shown in disconnected position.



2. Insert tubing with pre-swaged ferrules into the fitting body until front ferrule seats.

3. Tighten Nut by hand. Rotate Nut to original position with a wrench. An increase in resistance will be encountered at the Original position. Then tighten slightly with the wrench.



The tubing and fittings assembled can be tested for leak proof with soap solution. Any bubble appears indicate leak. Hold the body firm and tighten the nut slightly in order to arrest the leak.

Various types of fittings used in Pneumatic Line

1. Straight Union
2. Union Elbow
3. Union Tee
4. Swivel Elbow
5. Street Elbow
6. Male Connector
7. Female Connector
8. Male elbow Connector

9. Female Elbow Connector
10. Reducing Union Elbow
11. Reducing Union Tee
12. Reducing Union Run Tee
13. Male Branch Tee Connector
14. Female Branch Tee Connector
15. Male Run Tee Connector
16. Female Run Tee Connector
17. Male Elbow
18. Female Elbow
19. Female Tee
20. Flange Connectors

Periodical Maintenance

If the nut is found loose:-

(1) Completely unscrew the nut, check for any dust/dirt particle etc.
(2) Re-assemble as explained earlier.

Approved Sources

The Following are the approved sources for SS Tubes & Double Ferrule Fittings as on date

1. FLUID CONTROLS Pvt. Ltd. ,Mumbai.
2. EXCEL HYDRO PNEUMATICS Pvt. Ltd. Mumbai.
3. FLUIDTEQ SYSTEMS, Mumbai.
4. MARS RAIL FIT ENGINEERS ,Chennai.
5. PANAM ENGINEERS Ltd. ,Mumbai.
6. ASTEC VALVES & FITTINGS Pvt. Ltd. ,Mumbai.
7. VIPAL ENTERPRISES Pvt. Ltd. ,Mumbai.
8. HYD-AIR ENGINEERING Pvt. Ltd. ,Mumbai.

Swaging Machine

The Swaging machine can be procured from M/s Swagelok , Chennai, (or) the machine can be procured through the approved sources for SS Tubes & Double Ferrule Fittings

Note:-Long ferrule punch (8") should be available in tool box/bag of fitter gang for maintenance of ferrule joints. (**Ref.-Railway Board's letter No. 2014/M/(C)141/2 dt. 28.04.2014).**

Specification

For Technical Information/clarification, Please refer to Specification

ICF/MD/SPEC-166 (with Latest Revision/Amendment) available with ICF.

- The Ferrule fittings have been applied in air brake pipe lines of Indian Railway coaches. Air brake pipelines of LHB coaches are fitted with Ferrule fittings instead of screwed/welded flange joints.

- Precautions required on ferrule fitted Air brake pipelines:

    - Pipelines are to be clamped properly to avoid vibrations.
    - Vibrations will loosen the ferrule joints and lead for to leakage
    - Ferrule fittings should not be over tightened.

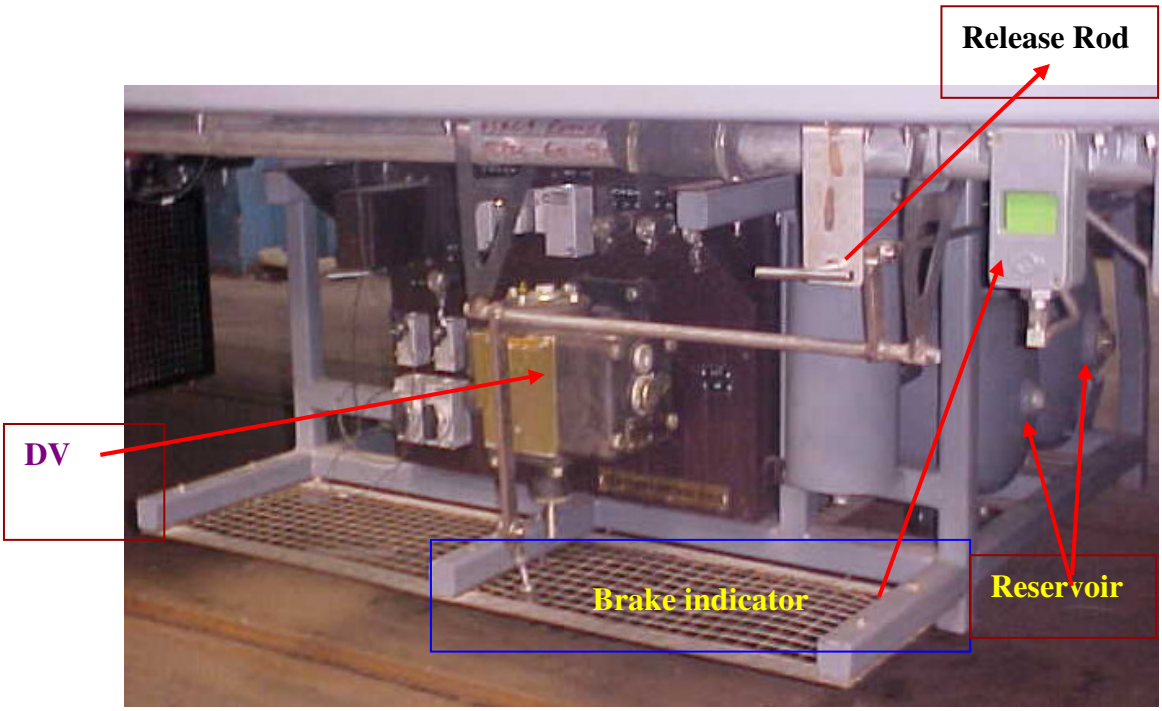
Chapter 9

Failures & Trouble Shooting

Brake Binding Attention and Isolation of Air Brake System

Sequential procedure of attending Brake binding in LHB Coaches:
Attention of Pneumatic Problems

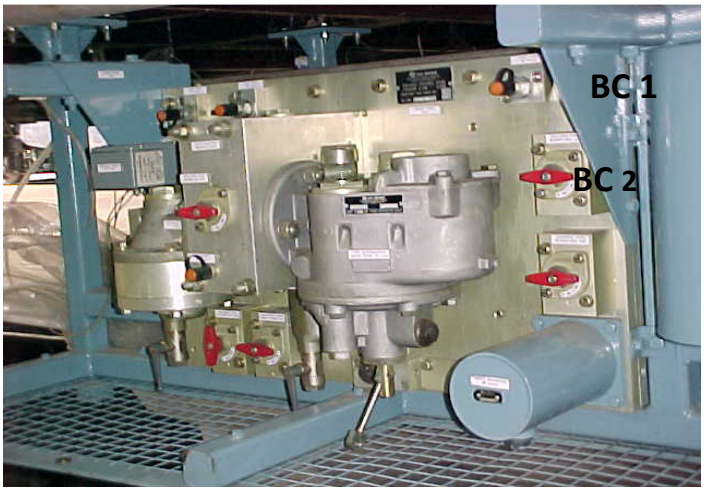
Step 1: Pull Quick release rod / Wire of DV provided.
With this CR pressure will be reduced and become equal to BP and BC will be exhausted and brakes should be released and brake indicators should show green. If brakes are not released through this step, follow step 2.



Step 2:

Close BC Isolation Cocks of both the trolleys (Bogie -1, Bogie-2) provided on Brake Control panel.

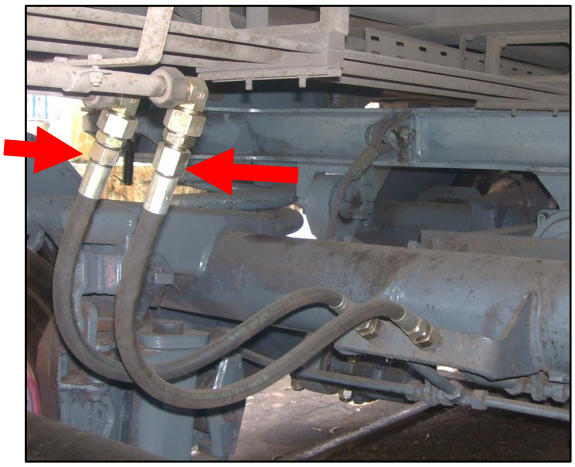
Isolation Cocks Position vertically downwards: Normal condition
Isolation Cocks Position Horizontal : Isolated Condition

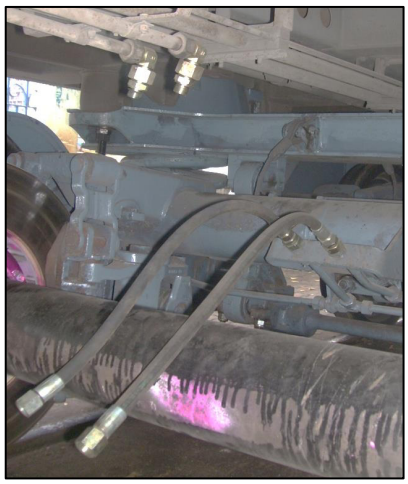


With this BC pressure exhaust through Isolation cock vent holes, brakes should be released and indicators should show green. If not released follow step 3.

Step 3:

Open flexible pipes of B.C. lines of one / both the axles ofone / both trolleys having brake binding using suitable open end Spanner. If suitable Spanner is not available, try to puncture/cut the flexible pipe to exhaust the BC pressure and brakes will be released.

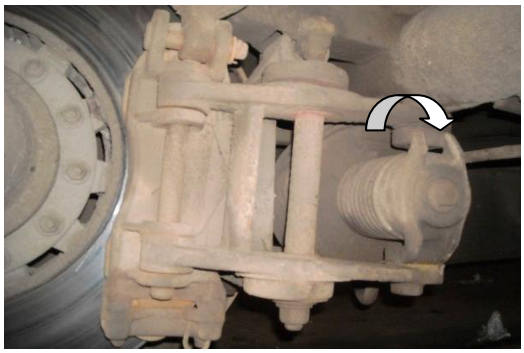


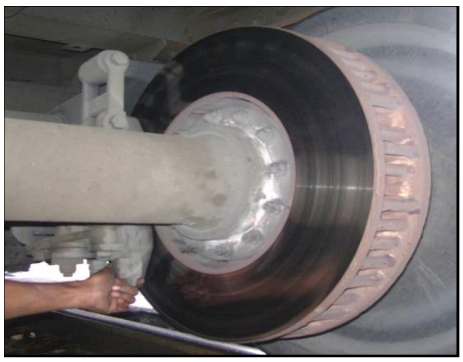


With this BC pressure will exhaust and indicators will turn to green, even though we have to ensure release of brake pads from brake discs by shaking manually. If brake pads are not free that means there is mechanical brake binding and follow step 4

Step 4: Attention to Mechanical brake binding

If there is any jam in the brake cylinder, calliper unit or less gap between brake disc and brake pad causes brake binding to release the brakes by Loosening the hexagonal nut of the brake cylinder by 27 no Spanner for all the coaches except power car which requires 46 no spanner. Check that the brakes are released by shaking the callipers and work the train.





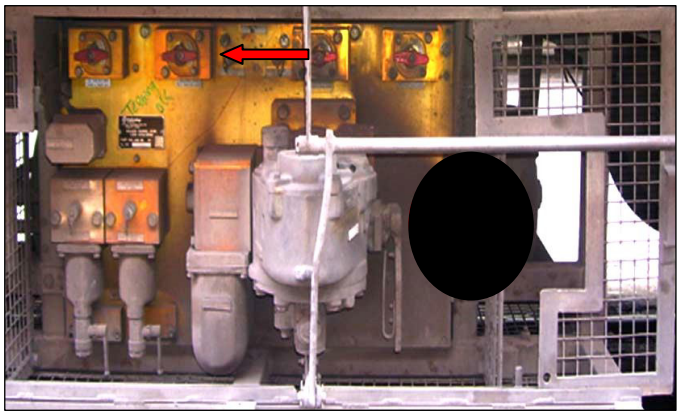
If not released, remove the brake calliper pivot pin of affected cylinder.

Isolation of Air brake system:

After ensuring release of brakes it is necessary to isolate the coach so that further brake binding can be avoided. For that Air supply to AR, CR, BC to be isolated and these entire three reservoirs to be emptied.

- Isolate FP Isolation cock fitted in Brake control panel

FP IC



- Isolate DV R – charger handle

Empting of Brake system:

- Empty the AR by opening the AR drain cock

- Empty the CR by pulling the QRV Rod again to empty the CR

- Isolate both BC Isolating cocks fitted in the brake control panel if not isolated earlier. Now the train can be allowed.

Cattle run over (CRO):

Action to be taken during CRO cases at enroute :

- Thorough examination of rake should be done & attend the damages at site and ensure no further detention.

The following items to be checked while attending CRO.

- Air brake system
- Watering system
- CDTS retention tank
- Foot board
- Brake control panel for damages/leakages.
- If the BP/FP metallic pipe is broken, by-pass the coach with the by pass length pipe.

ACP Resetting:

- To stop the train, pull the Pull Box handle down wards inside the coach cabin. After ACP pull, we will get Four indications, 2 inside the coach and 2 indications outside the coach.

Inside the coach:

- Red light (LED) glows in the Pull Box
- And Pull Box handle moves down by approx. 1 inch.

Outside the coach:

- Red light (LED) glows outside the coach on the top of Main Door.
- And we can hear BP leakage sound through PEAV 19 mm choke.

- For re-setting the PEASD, insert resetting key in the PEASD pull boxand rotate clock wise direction.
- If it is reset, all four indications become normal.

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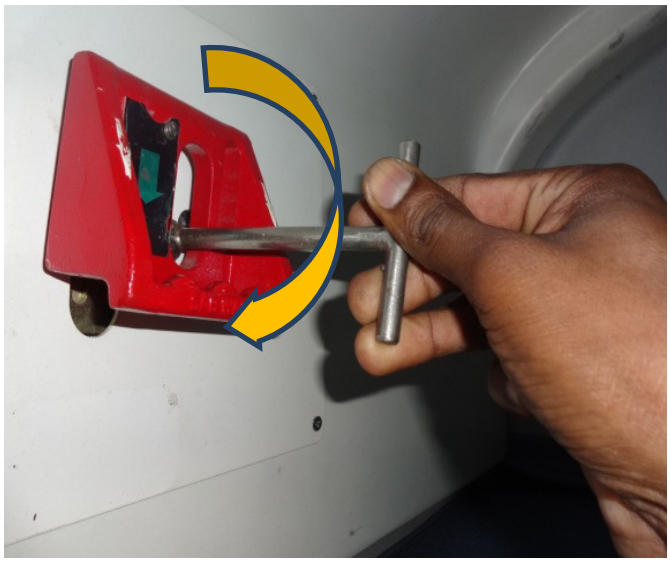
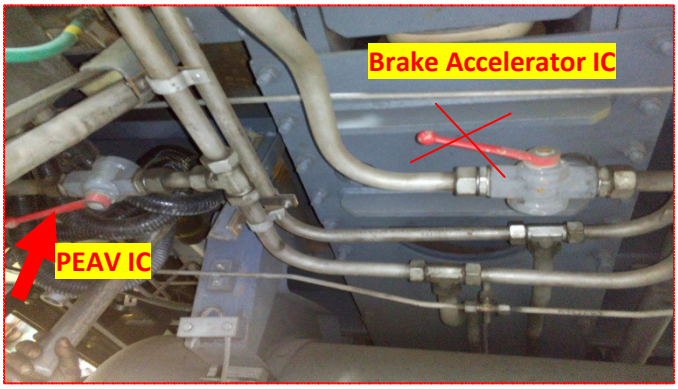


If it is not reset due to any defect in the PEASD, BP air leakage will not stop

- If BP air leakage does not stopeven after resetting, then closethe PEAV isolation cock provided underneath the coach.

For Double Decker coaches, the location of PEAV isolation cock is as shown in the figure.



Note: If PEAV isolation cock defective and not closed properly then there is a chance of continuous BP drop then there is no alternative than bypassing the pipe line with coach length flexible pipe.

By-Passing of B.P/F.P Main Pipe Line of LHB Coaches

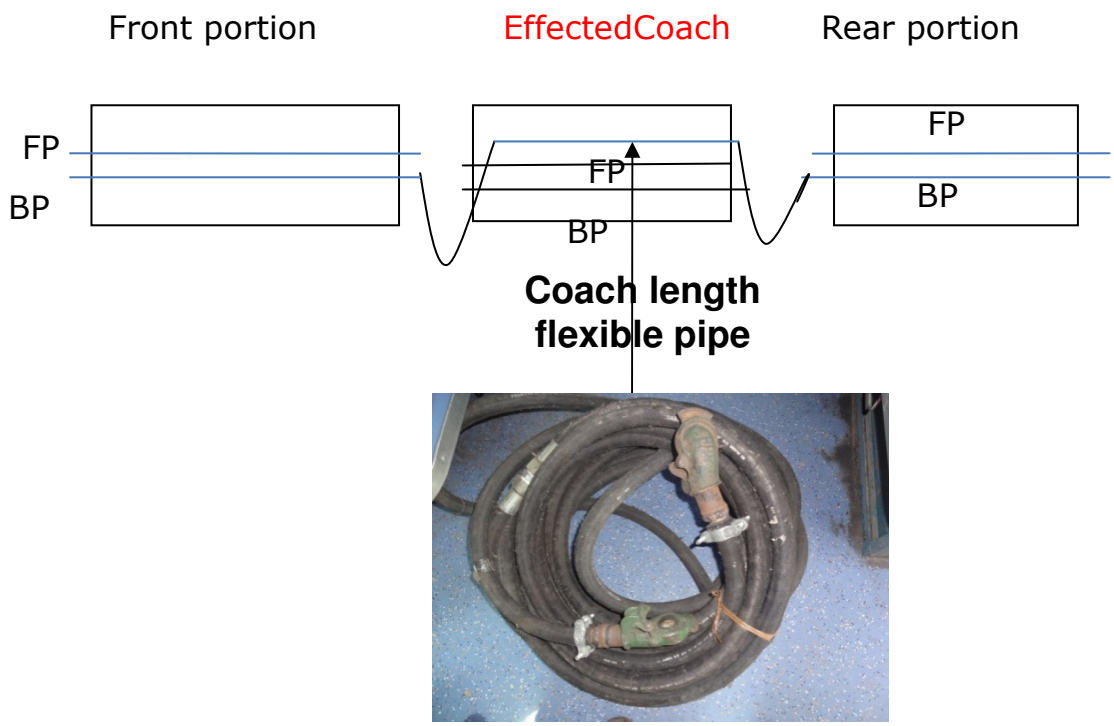
In conventional ICF coaches by-passing means allowing BP pressure from front coaches through FP pipe line of effected coach and again connecting to BP line of rear coaches and running the train with single pipe Air brake system.

But in LHB coaches the following systems will be affected with single pipe Air brake system

- Wheel Slide Protection System
- Air Suspension System if provided with Air springs
- Automatic door closing System / CDTS System

Need for by-passing of BP/FP main pipe line enroute

1. BP or FP metallic pipe broken.
2.Leaking from any part of the Air brake system which cannot be isolated or arrested in the main pipe line
3. Ferrule joints worked out.



BP Coach Length flexible pipe FP Coach Length flexible pipe BP/FP by pass couplers

BP coach length by pass flexible pipe can be converted into FP by attaching bypass couplers on both ends and vice versa.

PROCEDURE OF BYPASSING OF B.P. PIPE :

1. Close BP cut off angle cocks on both ends of the affected coach.
2. Close BP cut off angle cocks of both the adjacent coaches.
3. Un couple BP air hoses between affected coach and adjacent coaches.
4. Provide the BP bypass length air hose pipe from inside the affected coach.
5. Connect the BP bypass length pipe to both the adjacent coaches and open the BP cut off angle cocks.
6. Ensure manual release of affected coach and both the adjacent coaches.
7. The brake indicators of all coaches should display **Green** colour.
8. Check the BP pressures in front and rear power cars.
9. Ensure the air continuity by conducting air continuity test.

NOTE: Similar procedure is to be followed, if FP main pipe or branch pipe is broken, FP should be bypassed by using FP bypass length pipe.

Air pressure level becoming less or zero:

- Check for which pipe the pressure has become less or zero.
- Check whether the supply from loco is cut off.
- Check whether air hose in between coaches is uncoupled.
- Check whether there is ACP in any coach.
- Check whether there is any continuous leakage through brake accelerator.
- Check any leakage through steel pipe joints.

Chapter 10

M&P, T&P for LHB Air Brake Maintenance

M&P required at Sick line		
1	Synchronized electrically operated whitening jack capacity15 tonne (Set of 5 nos.)	2
2	Single car test rig for air brake system (Fixed)	1
3	Single car test rig (mobile) RDSO sketch No. 81110	1
4	Test bench for distributor valve	1
5	Test bench for brake control panel	1
6	Test bench for CDTS	1
Tools & Equipments required at sick line		
7	Square drive torque wrench 1” male square drive for fastening of Nuts and bolts of Bogie frame	1
8	Torque wrench (ratchet) torque 38 Kg-m sq. drive ¾”	4
9	Torque wrench (ratchet) torque 3-14 Kg-m sq. drive ½”	4
10	5 Torque wrench (ratchet) torque 7-35 Kg-m sq. drive ½”	4
11	Tool cabinet	- As per Requirement-
12	Feeler gauge	- As per Requirement-
13	Allen key set as per list	- As per Requirement-
14	Heavy duty rechargeable torch	- As per Requirement-

S.NO.	COMPONENT
M&P and Tools required at Pit line	
1	Tool kit (Torque wrenches, Allen keys, pliers, spanners set etc.)
2	Equipment for pneumatic System Functional Test
3	Single car testing rig for air brake system
4	Inspection torches
5	Ball peen hammers
6	Goggles for inspection staff

SN	DESCRRIPTION	QTY.
WORKSHOP M&P required		
1	Single car test rig for air brake system (fixed)	1
2	Single car test rig (mobile) RDSO sketch No. 81110	1
3	Test bench for distributor valve	1
4	Test bench for brake control panel	1
5	Simulator cum test bench CDTS	1
6	Single car test rig (mobile) RDSO sketch No. 81110	1
Tools & Equipments		
1	Phased array ultrasonic flaw detector	1
2	Ultrasonic air leakage detector	2
3	Portable hand drill machine	2
4	Digital stop watch with split time	6
5	Tool cabinet	As per requirement